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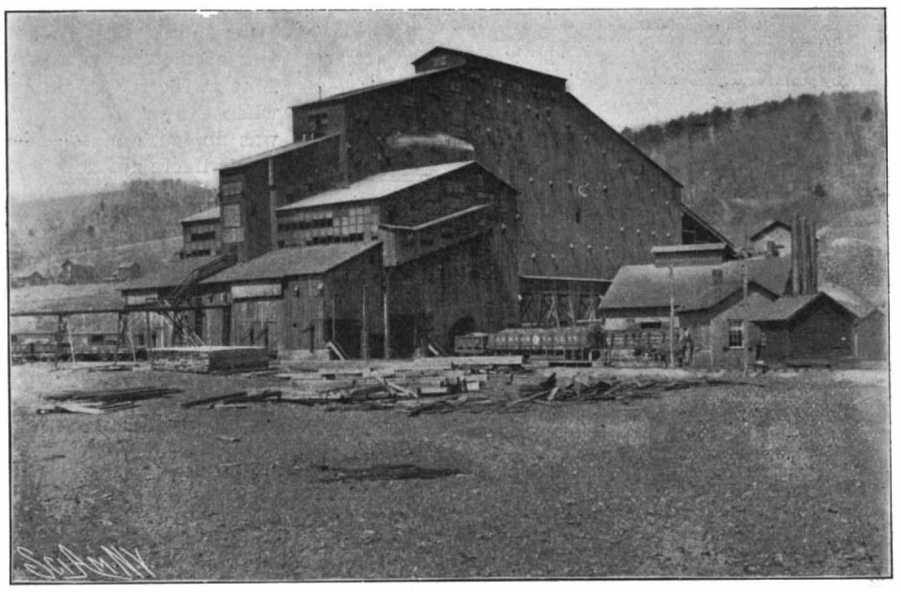
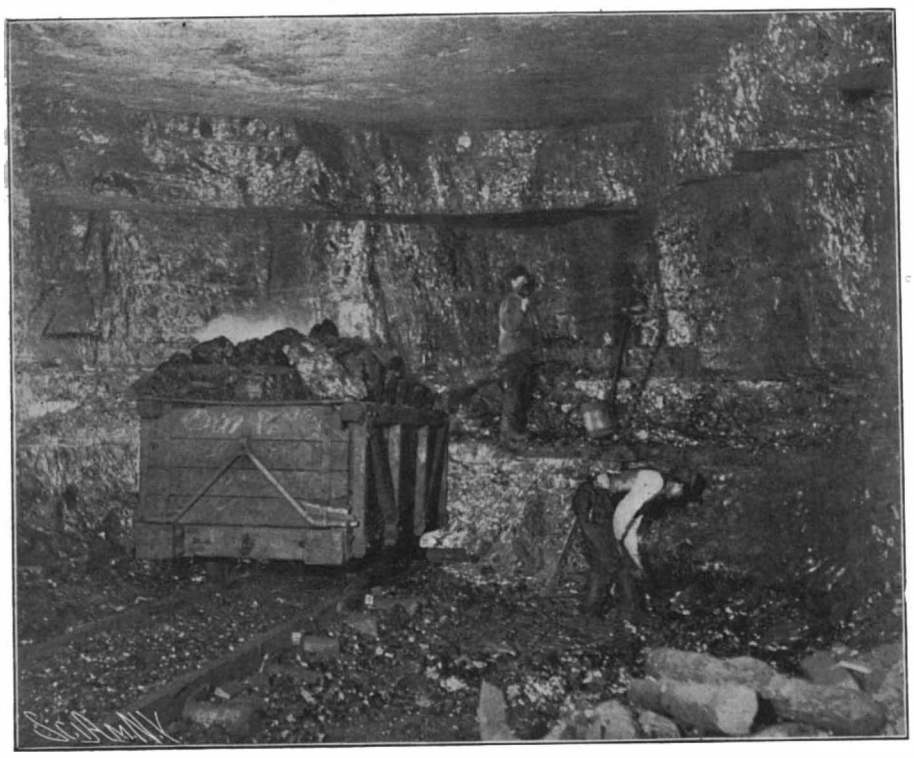
The Office of a Mine Foreman, 500 Feet Underground.

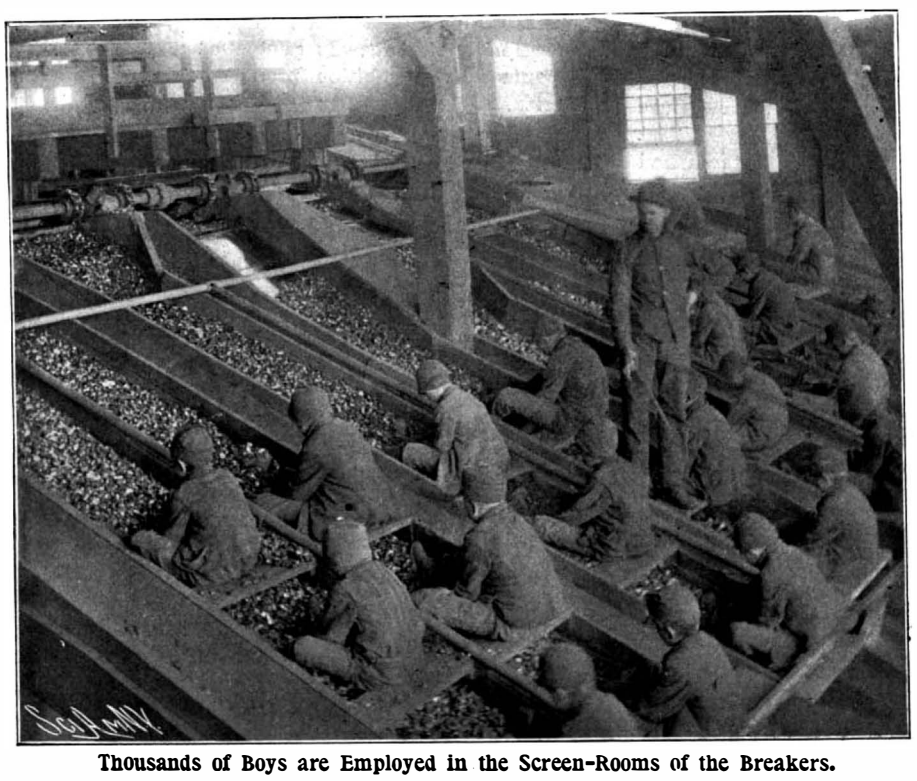


Exterior of Breaker in the Anthracite District.

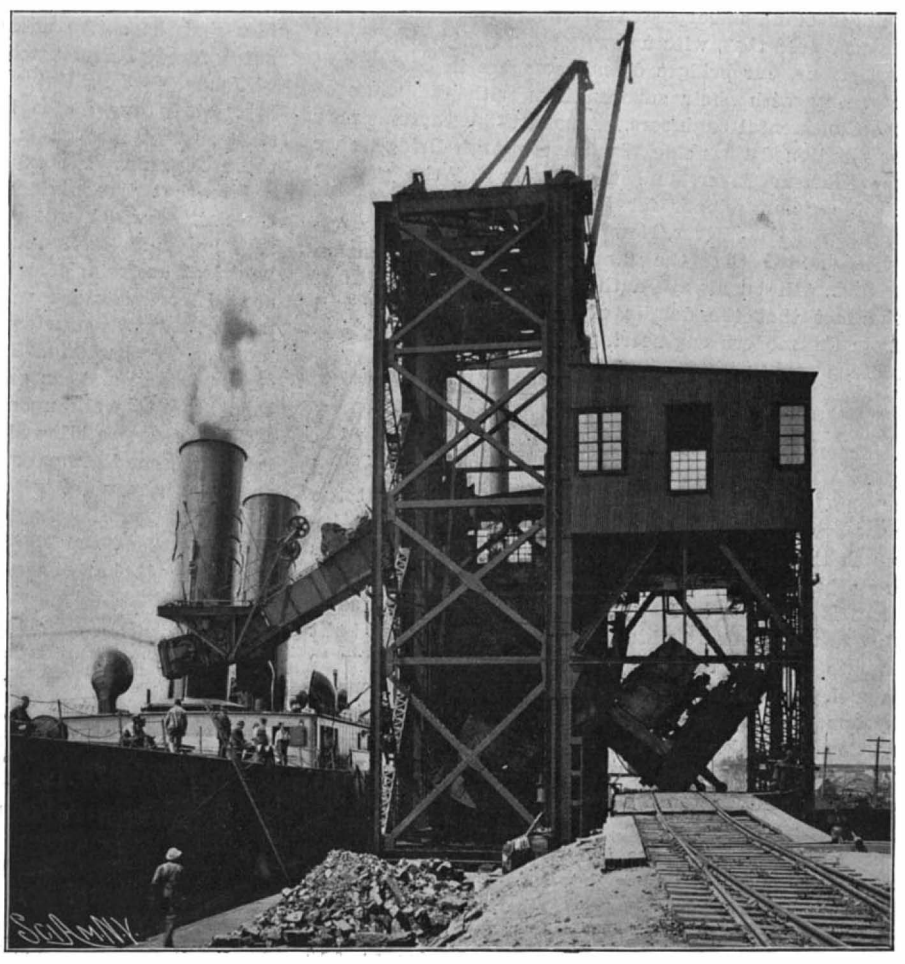


Anthracite Coal Mine Heading. The Roof is Higher than that of a Bituminous Mine Because of the Thickness of the Vein.

A Breaker Head.



Thousands of Boys are Employed in the Screen-Rooms of the Breakers.



The Great Coal-Loading Machine Lifting a Car from the Railroad Tracks Before Discharging its Contents.

THE ANTHRACITE COAL INDUSTRY.—[See page 392.]

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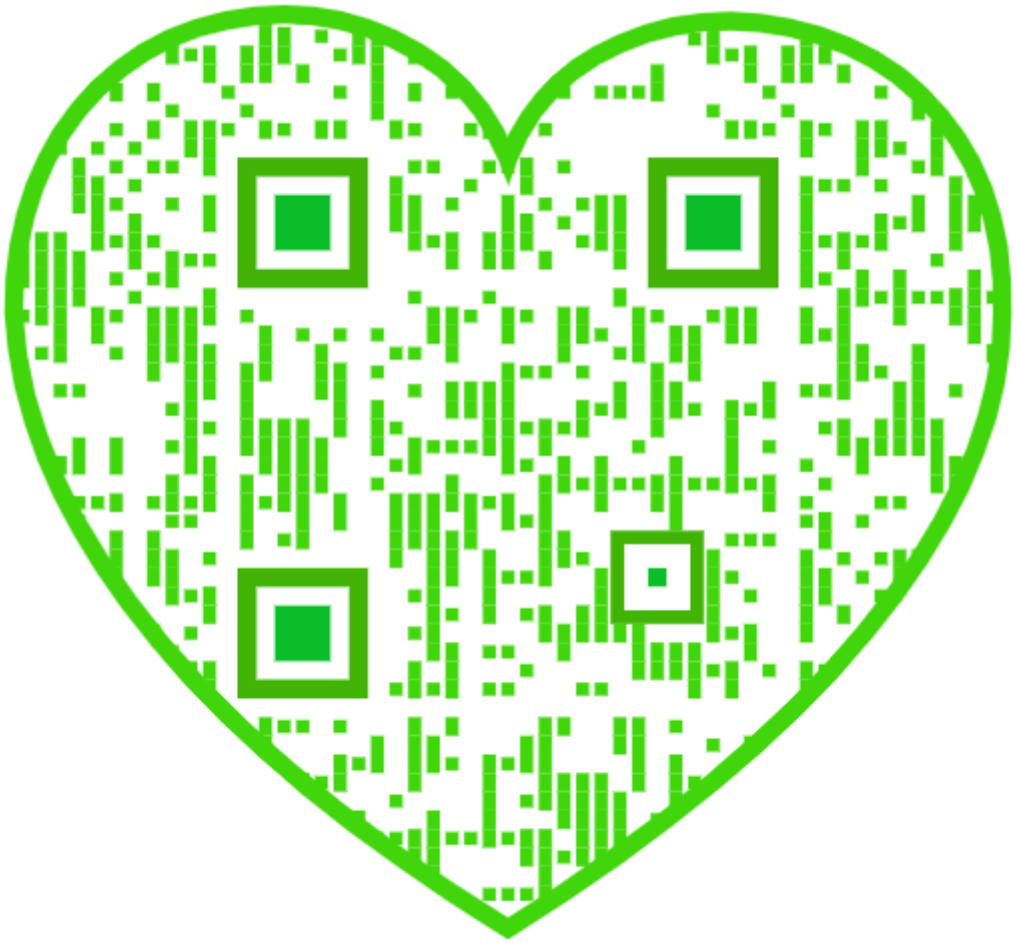

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NEW YORK, SATURDAY, MAY 23, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE ARTISTIC ELEMENT IN BRIDGE DESIGN.

At a time like the present, when we are constructing in this country, and notably at New York, so many important municipal long-span bridges, it is of interest to turn to similar work which is being designed and executed by foreign engineers and contractors. We present in the current issue of the SUPPLEMENT a series of views of some recent notable bridges constructed in Germany and Switzerland, which are characterized by that strict regard for the æsthetic and architectural side of bridge construction, which is such a marked feature in the best Continental work.

Thanks to the Municipal Art Commission, in the city of New York strict attention is being paid, and we hope will continue to be paid, to the artistic side of all bridges, great and small, that are erected in the metropolis. Of course, the architectural embellishment of an engineering structure is something that requires to be undertaken by the architect or artist in direct collaboration with the engineer who designs the structure. This collaboration is now being carried out; but it is quite a question whether the bridge engineer, particularly if he intends to devote himself to city or county work, would not do well to round out his professional course by including instruction in at least the elements of architectural design, or some kindred study. Hitherto, American bridge engineers have been governed in their work too much by the strictest considerations of utility; and in the endeavor to design bridges that can be built with the least expenditure of time and material for the maximum amount of strength, they have produced structures that are a literal translation into steel of the straight lines and angles of the strain-sheet diagram. For economy of material and speed of erection, these bridges stand unsurpassed in the world; but it must be confessed that, with a few notable and praiseworthy exceptions, our bridges do not compare in beauty and harmony with their surroundings with the work of the Continental engineers. Among the exceptions may be mentioned the noble Washington Arch Bridge, over the Harlem River, and the design by the present Bridge Commissioner for the new Manhattan Bridge across the East River, New York; while it need scarcely be added that the famous Brooklyn Suspension Bridge will be always a thing of beauty, in spite of the fact that the details of its construction, judged from the modern engineering standpoint, must be considered rather crude.

AMERICAN RAPID TRANSIT IN LONDON.

The managing director of the Anglo-American Company which is building and equipping a large section of the London Underground Railways, states that the vast system of rapid transit which is being built beneath the city of London is progressing with far less disturbance to the streets and discomfort to the public than is our own in New York city. The difference is due to the depth at which the "tubes" are being built and to the fact that the material is soft and easy to tunnel. The most remarkable feature of the London system, according to Mr. Yerkes, is the great power station on the bank of the Thames, from which power for the entire system will be furnished. The building will contain ten 7,500-horse power engines, and when the plant is all in, there will still be room in the building to increase the power capacity by fifty per cent. An interesting detail of the enterprise is that a portion of the system is being equipped with four rails, of which two are the main rails for the cars, while of the other two one is the feeder, and the other the return rail for the current. The placing of the fourth rail is due to one of those government regulations—so common in Great Britain—that are inserted for the protection of the general public when important franchises are granted to public corporations. In the present case the Board of Trade stipulated that there must not be a drop of more than three or four volts in the pressure of the return current as received at the power house. The object of this restriction is to prevent leakage with its well-known disastrous electrolytic effects on gas and water mains. Now, it would be impossible to prevent leakage, if the common system of return by way of the track rails were adopted; since the ordinary vitrified earthenware insulators could not be used between rail and track. Hence the necessity for a separate properly-insulated return rail.

THE NEW CUNARDERS.

Some interesting light was thrown upon the subject of the two new express steamers for the Cunard Line at the recent annual meeting of the shareholders, when the president of the company stated that there was no truth in the report that the objections of the shipbuilders are due to their inability to construct two ships of the huge proportions and high speed called for by the government requirements. It seems that the shipbuilding firms consulted are fully prepared to build these vessels, which are to be of the same beam as the "Cedric," 75 feet, and are to be about 150 feet longer than the "Kaiser Wilhelm II." Moreover, they are prepared to guarantee that they shall show an average sea speed of 25 knots an hour, which is a knot and a half better than the highest speed for a single voyage ever made by a transatlantic steamer, and is over two knots higher than the average sea speed for a whole season of any existing ship. The government requirements, however, demand that the average sea speed, voyage by voyage, shall be 25 knots, and to insure this result the vessels would have to be capable of making an average speed for a single voyage under the best conditions of wind and sea of not less than 26½ to 27 knots an hour. As matters now stand, the British government expects the company to put these two ships in service with the stipulation that if they do not maintain an average throughout the season of 25 knots, they will be thrown back upon the shipbuilders' hands. As the two vessels will cost about $10,000,000, it can readily be understood that private firms are reluctant to undertake the contract subject to such onerous conditions.

The obligations imposed upon the builders of German express steamers are that the ship must give satisfaction on the trial trip, and that the builders must be prepared to remedy any defects that may show themselves during a specified period of their service; and these requirements would seem to be sufficiently exacting to protect the interests both of the government and of the steamship companies. It begins to be pretty evident that unless the government makes a considerable modification of its demands, the 25-knot steamers will never get beyond the paper stage.

FLIES AS CARRIERS OF BACTERIA.

There is, of course, nothing new in the theory that flies may be active agents in the spread of bacteria, but a forceful demonstration made under the auspices of Johns Hopkins University, which has been recently brought to our notice by a member of the medical staff of that institution, is well worthy of record in these columns. The experiments were conducted with a box that was divided into two compartments, in the first of which was exposed some food material infected with an easily-recognizable species of bacteria—harmless bacteria, of course, being used—while in the second compartment was placed an open dish containing a sterile nutrient such as is used as a culture medium for bacteria. Flies were placed in the first compartment, and, as soon as a number of them had been seen to walk upon, or eat of, the infected material, they were allowed to pass through a small door into the second compartment, where they had a chance to come in contact with the culture medium in the dish. The result was that bacteria deposited upon the surface of the sterile nutrient, multiplied there, and formed characteristic colonies. In these experiments molasses mixed with a growth of yellow bacteria was spread on a plate in the first compartment, and a dozen flies were put into the apparatus. Half an hour later, the door between the two compartments was opened, and as soon as several of the flies had been seen to come in contact with the sterile nutrient, the dish that contained it was covered and put away to develop. A few days later there had grown on the nutrient over a hundred colonies of yellow bacteria. The experiment was repeated with red and violet culture, and colonies of corresponding color were obtained. To prove that the germs from which these colonies grew came from the infected material in the first compartment, and not from accidental sources, further experiments were made with other groups of flies, but with no infected material in the first compartment. In this case, however, none of the dishes used in the second compartment developed yellow, red, or violet colonies. To prove further that the flies were the only means of transmitting the bacteria, experiments were made with infected material in the first compartment, but with no flies in the apparatus. The dishes containing the nutrient in these experiments also developed no colonies; and from these results it was considered to be absolutely demonstrated that flies are capable of carrying bacteria from one place to another, if they have an opportunity to come in contact with material containing these organisms.

BRITISH WORKMEN ON AMERICAN INDUSTRY.

The Mosely Industrial Commission to the United States, of which we have lately heard so much, was organized by the gentleman after whom it is named, who offered to pay the expenses of a certain number of secretaries of British trades unions for a visit to this country, in order that they might examine and report upon American industries. Not only did Mr. Mosely provide the necessary funds, but he accompanied the delegation himself; and the report of the findings of the various delegates is prefaced with one by himself, which is perhaps the most valuable, because of his broader point of view and his more philosophical treatment of the subject. There are in all twenty-two separate reports by the trades union delegates, representing as many different British industries. To insure that the field should be fully covered, a list of forty-one questions was proposed, which each delegate was requested to answer as far as he could. These questions related to the early training of the workmen in America; their general social condition; and the relations between employe and employer. The organizer of the commission reaches the conclusion that "The true-born American is better educated, better housed, better fed, better clothed, and more energetic than his British brother, and infinitely more sober. As a natural consequence, he is more capable of using his brains as well as his hands."

The commission as a whole agreed with Mr. Mosely. The reports are practically unanimous on the question of sobriety, although one of the delegates considers that "while the American workman is sober during working hours, yet he is as much inclined to a spree as the ordinary Britisher." On the question of gambling, it is considered that the American workingman, as such, knows practically nothing about it, and in this connection we are surprised to learn that the wagering habit is increasing rapidly in the present day among British workmen. Mr. Mosely draws attention to the fact that many of the leading positions in industry in America are held by men who are either English or Scotch. The delegates agree with him in the statement that one of the chief reasons why the American workman has an advantage over his British brother is that he has received a more thorough and generally better education. There can be no question that one of the chief inducements to self-improvement in American education, is the reasonable hope of advancement that social conditions hold out to young men of all classes in America, if their abilities fit them to fill higher positions. The delegates frequently allude to the great appearance of equality or absence of restraint in the intercourse between the masters and men. "But this," it is asserted, "is an effect and not, as seems to have been imagined, a cause. The American employer has more sense of the value to himself of what may be comprehensibly described as talent among those who do the work of the establishment than his British *confrère*." In this connection an instance is quoted of a young British mechanic whose ambition prompted him to come to America, and who was rapidly promoted until he became manager of one of the largest works in the United States, which under his vigorous direction forms one of the most successful in the country. It is urged that a little encouragement of the same sort would doubtless have kept the workman at home, with a benefit to English industry which it is difficult to estimate.

There is no doubt whatever that just here is to be found at once one of the greatest secrets of our industrial success in the United States, and of the comparative stagnation in many British industries. In Great Britain a workman or subordinate who presents a new device or theory to a superior will more likely than not be coldly received for his trouble. Here a premium is placed upon ingenuity and useful suggestions. Another most fatal hindrance to successful competition on the part of Great Britain with her Continental and American rivals is the fact, as pointed out by Mr. Mosely, that, "It has been the rule for generations past that as soon as a man earns beyond a certain amount of wages, the price for his work is cut down, and he, finding that working harder or running his machine quicker (naturally a greater strain) brings in the long run no larger reward, slackens his efforts accordingly." We are informed that this policy is rapidly passing away; and surely it is high time; for under such a system, there

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can be no growth of that sense of community of interest, which is absolutely essential to secure the best results in the industrial world.

On the important question as to whether the American is on the whole better off than the English workman, the delegates point to the fact that while he receives higher wages, he has to work longer hours; and that though the wages are higher, the cost of living is greater. The general trend of opinion is that after income and expenditure have been balanced, the American is found to be better off than the British workman, to the extent of twenty per cent or so. This estimate, however, cannot be applied too broadly, for the reason that conditions differ considerably in different parts of the United States.

ELECTRIC POWER PLANT BELOW MOUNT RAINIER.

BY EARL MAYO.

The glacier-capped mountains of the Pacific coast offer excellent facilities for the development of hydraulic-electric power. To utilize the glacier flow, a power plant, the largest on the coast, is now being constructed, which will deliver electrical energy to the principal cities of Washington for the street railroads, interurban lines, and lighting plants, and also for mills, factories, and the principal commercial concerns.

The original source of the water power will be the great glacial cap of Mount Rainier, which towers 14,519 feet above sea level and is constantly reinforced by the warm mists and rain-clouds which are brought inland from the Japanese current which impinges on the neighboring coast. The moisture in the air, striking this great ice-cap, high above the limit of vegetation, is condensed, so that the glacial covering is constantly growing from the top while it is being melted away from the bottom. The present undertaking necessitates the damming of the Puyallup River below its junction with the Mowich at an altitude of about 1,700 feet above sea level. Owing to the peculiar formation of the mountain above this point, the Puyallup River drains not only the Mount Tacoma glacier, the Puyallup glacier, the South Mowich, North Mowich, and the Carbon glaciers, but also Crater Lake, into which the Carbon glacier discharges. From beneath the glacial ice, whether it ends in a precipitous cliff or presents a confusion of broken ice, cold water flows throughout the whole year. The hidden streams which flow for several thousand feet between the ice cap and the granite surface of the mountain, burst from beneath the edges of the glaciers with a loud roaring, and sometimes the curtain of water which leaps out, although of slight depth, may have sufficient force to carry a man off his feet.

Below the ice, in the almost impenetrable forests, the rainfall is perhaps greater than in any other part of the country. The wind which brings the mists ashore is always temperate, and the side of the mountain is sufficiently abrupt to catch the precipitation from clouds at varying elevations, while the dense woods tend to the preservation of all falling moisture. From experiments made in the neighborhood it is estimated that the annual rainfall on the western slope of Mount Rainier aggregates 150 to 160 inches. The rainy season begins in October and continues into the early summer—nearly every day during this period showing some appreciable precipitation. During this season there is more water available than is needed, and it happens therefore that the flow from the glaciers, although it never fails, is diminished by the cold weather. During the dry season, including the months of July, August, and September, when little or no rain is expected, the glacial flow is at its height and can be relied upon to provide an ample supply of water.

The water power which nature has stored in this cap of ice is regulated to the demands of man not only by its yearly variations, but also by the so-called glacial tides, which are manifest daily. The greatest flow from the glacier, owing to the influence of the sun, occurs from perhaps eleven in the morning until four or five o'clock in the afternoon. Owing to the distance that this water travels before being utilized for power, these high tides will reach the power station five or six hours later, and therefore the largest daily supply is available between five in the evening and eleven at night, when the city's illumination and street car travel make the greatest drain upon the plant. The glacial tides show a rise of perhaps two inches where the stream is broad, and of two feet where the water of the stream is crowded into a narrow channel, and they are the means of great economy, since, to a large extent, they regulate the power without artificial intervention.

At the point where the Puyallup River is being dammed, a series of rapids start, and extend to the comparatively level ground about 900 feet below. While the river normally travels down a cañon, it will be diverted by a flume and ditch along a bench or spur of the mountain, until it approaches a point above Lake Kapowsin, where there is an almost sheer decline to the foot of the rapids. The flume will be built with a section of eight feet wide by seven feet high, and will carry 2,000,000 tons of water daily. Here the canal, which will be ten and a half miles long, will discharge into a forebay or reservoir, which will hold sufficient reserve supply to operate the plant during any necessary repairs to the flume or ditch.

From the forebay, four steel pipes 1,700 feet long will carry the stream down the declivity at an average angle of 45 degrees, to the power station, which will be situated at the beginning of the level country below. When the necessary reductions are made for friction, the pipes will hold columns of water with a net head of about 850 feet. This is to say, although the pipes will descend diagonally, the water efficiency will be as great as if they descended vertically 850 feet. From these great steel pipes, which will be four feet in diameter at the top and taper to a five-inch nozzle, a compressed stream of water will be released with a spouting velocity of about 15,000 feet, or nearly three miles a minute. This stream will be released in the shape of a solid round bar which strikes the cups of an "impulse" or tangential water wheel, so that the greatest efficiency known to hydraulics may be attained. The four impulse wheels will be connected directly to the generators, which are now being built by the General Electric Company, and which will be unequaled by any now employed west of the Rocky Mountains, having a capacity of 3,500 kilowatts, or 5,000 horse power each. An alternating current of 2,500 volts will be generated and stepped up to 45,000 or 55,000 volts, and then transmitted to Tacoma, which is about 30 miles, and to Seattle, which is about 45 miles distant.

The engineers have completed the laying out of the flume and ditch line, and while the great generators and water wheels are being constructed, several hundred workmen are employed in clearing away the giant trees and rocky ledges that stand in the way of the free passage of the water between the diverting dam and the forebay. Meanwhile, also, preparations have been made for laying the great steel pipes down the face of the headland, and concrete anchors will be set into the hill to sustain the enormous weight of 1,700 feet of water, and prevent the pipes from forcing their way into the power house. Each tangential wheel receiving its impulse from this weight of water will revolve with a speed that would send its periphery 7,000 feet a minute, and the four wheels will develop 20,000 horse power.

CARRIER PIGEONS FOR THE GERMAN NAVY.

For some time past severe experiments have been conducted by the German naval authorities to ascertain the suitability of the carrier pigeon for intelligence service in the navy; and so successful have these trials proved, that permanent pigeon stations are to be erected. The chief of these will be at Wilhelmshaven and Helgoland for the North Sea, and at Friedrichsort for the Baltic. To assist the Admiralty in its scheme, sixty-one carrier pigeon clubs have placed their services at the disposal of the authorities. Six of these clubs have stations on the east coast—two at Kiel, two at Rendsburg, one at Nortof, and one at Lubeck—while there are no less than forty-two stations on the North Sea coast—sixteen at Hamburg, four at Bremen, the others being distributed over the country of the Lower Rhine, between Crefeld and Düsseldorf. The Naval Department will thus have sufficient birds and conveniences at their disposal and will defray the cost of conveying the baskets containing the birds to the various warships, and the return of the baskets to the respective clubs to which they belong.

From the results of the experiments it is estimated that the birds have sufficient endurance to fly home from a point 300 kilometers from land; and to insure the rapid delivery of a message to the desired quarters from a war vessel at sea, a system of duplicating the messages is to be adopted, varying with the atmospheric conditions prevailing at the time of dispatch, the distance to be covered, etc. For instance, up to 80 kilometers two birds will be released bearing the same message, and from 80 to 300 kilometers from three to five birds will be dispatched. Naturally, the time occupied by the birds in flying over the distance to be traversed depends upon the capabilities of the messenger, and the weather, but it is estimated that one kilometer per minute is the minimum speed likely to be attained.

The general practice of sending the message in a quill attached to a tail feather will not be adopted, as this has been proven to be generally unsatisfactory. Instead, the message will be inscribed upon thin vegetable paper, which will be slipped into an India-rubber case and secured to the bird's foot by means of a ring of the same material. As the birds arrive at their respective homes on land the messages will be detached and forwarded unopened to the news-collecting office and there dealt with. At the pigeon stations on the North Sea coast, there are wireless telegraph stations, and the messages will therefore be retransmitted thence to the head office. For this service special regulations have been prepared. In future every warship, except torpedo boats, leaving Kiel or Wilhelmshaven will be compelled to carry a consignment of carrier pigeons to be released at varying distances from the land stations. The utilization of carrier pigeons for intelligence purposes has long been in vogue in the German army, with conspicuous success, and this latest development will mark a new departure in naval warfare.

SCIENCE NOTES.

Dispatches from the Bourges observatory show that the sun after a long period of quiescence has again entered into a state of activity. On March 27, there was visible on the solar disk a large spot measuring 1,864 miles in diameter. Again, on March 30, four sun spots, two of them extensive, were observed.

C. Hartwich and W. Uhlmann state that the fat of gentian root is not a saponifiable oil, but a cholesterin-like body. The chloroformic solution, when treated by Hesse's test with concentrated H_2SO_4, colors the acid a bright red with a green fluorescence, and the chloroformic layer passes from yellow to red, and finally, after standing for twenty-four hours, to violet. By Liebermann's test, treating a solution in acetic anhydride with concentrated H_2SO_4, a red color, passing, on shaking, to bluish-green, and finally olive green was obtained. A similar cholesterin reaction also resulted with Salowski's test. The fat was extracted from the root by means of ether. It occurs to the extent of 5.67 per cent, and forms a dark yellow, viscous substance, having the characteristic odor and taste of the drug. By shaking out the petroleum ether solution with water and alcohol, 50 per cent, the odorous and bitter principle is removed.

That there are bacteria, some large fungi, and rotten woods which give phosphorescence or shine in the dark, has long been known, but it is a question whether there are shrubs or flowering plants that have the same property. Dr. H. Beckurts has recently, however, discovered a notice printed in 1845, stating that at the session of the Royal Asiatic Society, held April 5 of that year, the dry roots of an Indian plant were exhibited which possessed the property of shining or phosphorescing in the dark. An Indian officer, so goes the story, who took shelter from the rain under some projecting rocks, observed that the neighboring grass phosphoreseed, and he gathered several specimens of the grass and brought them to General Cullen. The latter stated that the plant was long known to the Brahmins under the name of "diotishmati," belonged to the family of the vegetable Sapindaceæ, and was identified as the *Cardiospermum halicacabum*. This, however, cannot be, since Lindley, who presented the root to the association, stated that it was a rhizome of a monocotylic plant of the Orchidaceæ or Iridaceæ. According to Watson the Indian plant "diotishmati" belongs to the grasses. It is, however, believed that the fact in the case was that the plant was probably covered with one of the phosphorescing fungi, which caused the error of observation in the young officer.

Mr. F. W. Very, of the Allegheny observatory, recently published a series of measurements on the radiations received from different portions of the solar disk. The measured amounts of radiation were found to diminish outwardly from the center, contrary to the assumption of a uniformly absorbing atmosphere. Taking Mr. Very's figures as a basis, Prof. Arthur Schuster, of Manchester, publishes in the Astrophysical Journal an examination which shows that the difficulty of explaining the law of variation of intensity across the sun's disk is readily removed by placing the absorbing layer sufficiently near the photosphere and by taking accounts of the radiation which this layer, owing to its high temperature, must itself emit. There is no reason to look to a different region in the sun's atmosphere for the cause of the observed diminution of radiation than that which gives the Fraunhofer lines. The simplest supposition to make at present, and one consistent with our knowledge of spectra, is that the layer which gives the line-absorption absorbs also to some extent all wave lengths extending from infra-red to violet, and that the diminution in the observed intensity of the solar radiation toward the edges of the disk is due simply to this absorption. The principles developed in this paper may find a wider application. Some observers have been puzzled by the fact that the radiation of the umbra of sun spots does not diminish as it nears the edge of the sun in the same way as that of the luminous disk itself, but, on the contrary, remains nearly constant. This investigation shows that in the case of the solar disk only about half of the radiation comes from the photosphere and that the rest is made up by the radiation of the absorbing layer itself. If that absorption, either by increased density or by greater thickness, is increased four or five times, practically the whole of the radiation would come from the absorbing layer and would be nearly constant for different portions of the solar disk.

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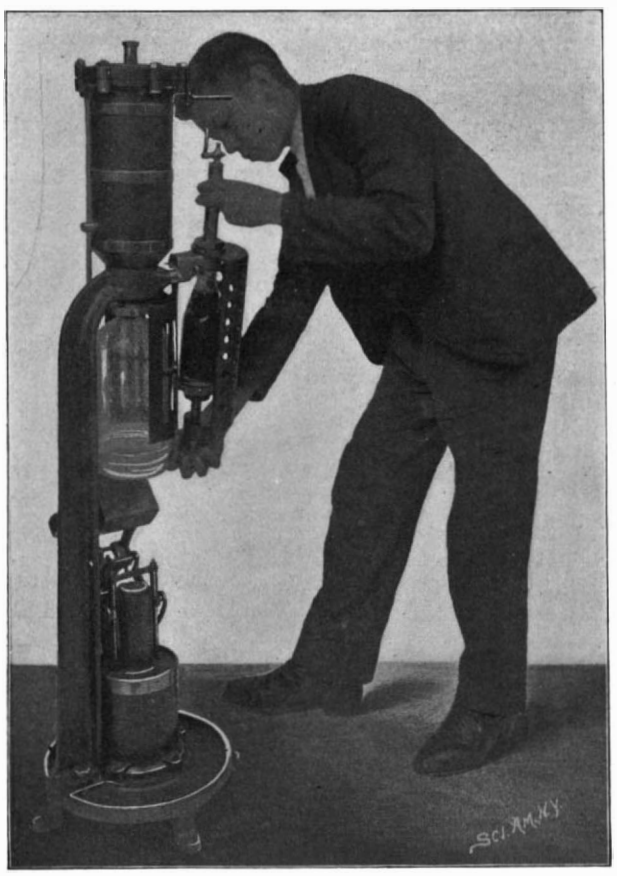
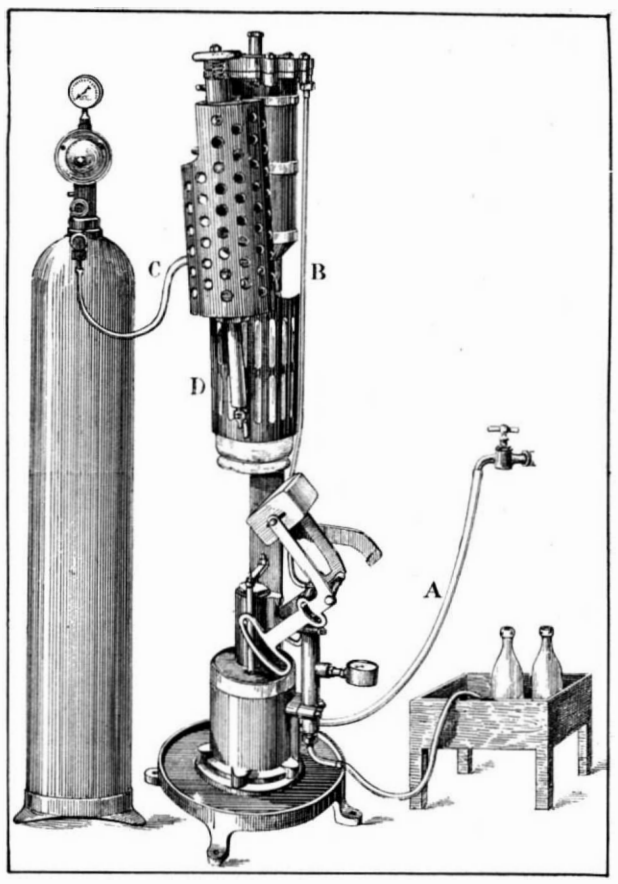
A NEW SODA-WATER MACHINE.

In the manufacture of soda and mineral waters, it is important that the water to be charged should come into contact with carbonic acid in the form of a fine spray or a thin film, in order that it may be thoroughly saturated. In the machine herewith illustrated, the water is spread out into a thin film by being forced through the unglazed porcelain walls of the chamber, and it there comes into contact with the carbonic acid which is held under a pressure of a few atmospheres. The water of a city supply system does not usually have sufficient pressure to force through the pores in the porcelain, and it is, therefore, necessary to raise the pressure by means of a transformer. The machine is, therefore, equipped with a water motor driven by the city water supply which multiplies the pressure several times. In one of our illustrations the supply pipe is indicated at *A* and leads from a faucet to the transformer at the bottom of the machine. From this point at a greatly increased pressure it is conducted up the pipe, *B*, to the top of the machine, where it passes through the porcelain walls of the carbonic-acid chamber. Within the chamber the water oozes out in tiny globules which trickle down the sides of the wall and are thoroughly saturated with carbonic acid, which is supplied from the tank, *C*. The saturated water then passes down into the reservoir, *D*, whence it may be drawn off into bottles as illustrated. The capacity of the machine depends largely upon the pressure employed. If local circumstances permit of artificially cooling the water, this, also, may add a great deal to the productive power of the apparatus; for it is a well-known fact that water of a low temperature absorbs a greater quantity of carbonic acid in the same space of time and under the same circumstances than it does at a higher one; for example, one quart of water at 0 degrees Cent., under a pressure of 5 atmospheres, will absorb 8.65 gallons of carbonic acid, and at 12 degrees Cent. will absorb only 5.15 gallons. The soda water obtained from this machine will be very pure; for on being passed through the unglazed portion the water deposits there not only all floating particles, but at the same time any disease germs it may contain. Where no water pressure is available for driving the water motor, a special form of machine is provided, in which the pressure of the carbonic acid is utilized to force the water into the saturating chamber. This form of machine will be especially useful at country resorts, on board ship or for army use, to afford an economical yet very efficient means for producing pure carbonic drinking water. The machine is the invention of Mr. Jan Frederik Beins, and is being introduced by B. F. Hagan, of Wijnstraat 116, Rotterdam, Netherlands.



FILLING A BOTTLE FROM THE SODA-WATER MACHINE.



DETAILS OF THE SODA-WATER MACHINE.

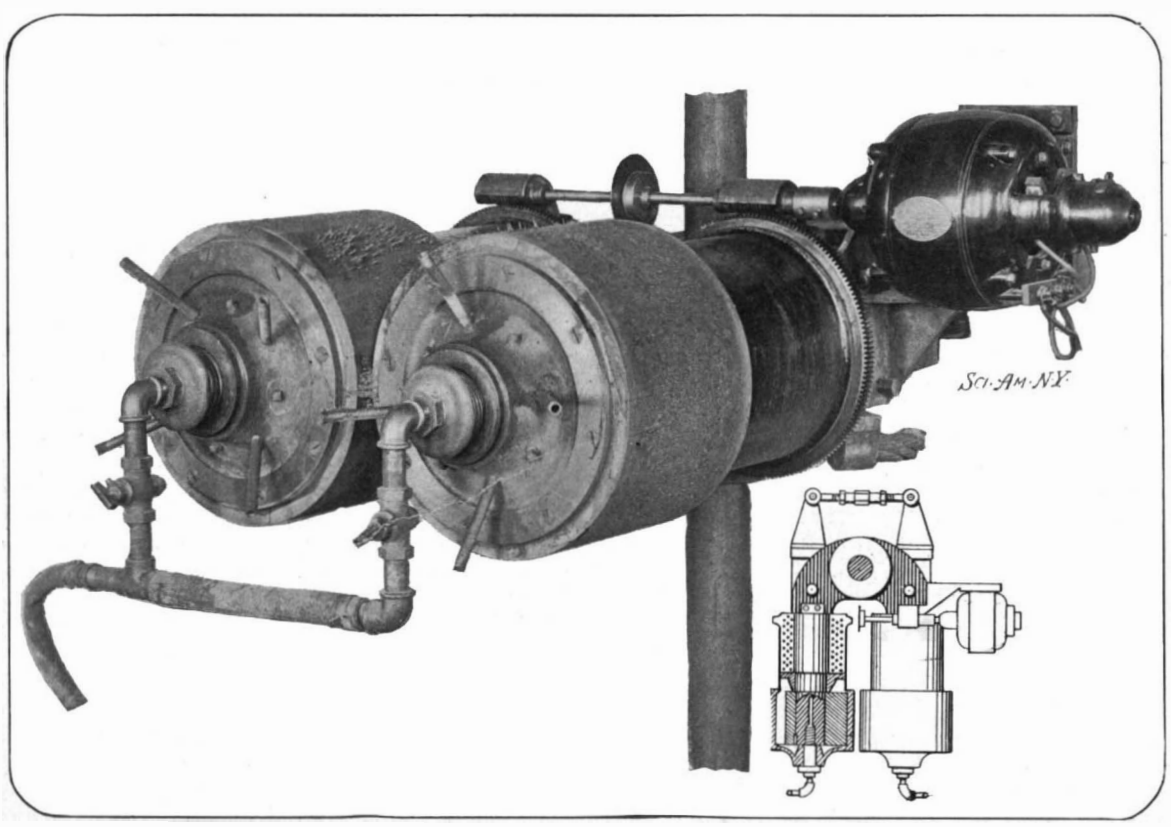
Cost of Warship Construction.

Owing to the general understanding between the various shipyards of Germany, whereby prices can be conveniently arranged, and inter-competition thereby averted, the Reichstag has passed a remarkable resolution to create competition between the various shipbuilding firms undertaking the construction of German war vessels, by which it is hoped the cost of building may be reduced. The gist of this resolution is that foreign firms be allowed to compete for the construction of vessels for the imperial navy, and the Reichstag emphasized its determination to force prices down by countermanding orders for two new boats, and reducing the sum of $500,000 for altering a cruiser to $125,000. An interesting comparison of the construction of German and British war vessels has been drawn up, whereby it is shown, although absolute relative costs, owing to slight variations in the sizes of the equipments of the vessels of the respective powers, are unavailable, that the English war vessels are built much cheaper than corresponding warships in the imperial navy. For instance, the German third-class type of cruisers of 2,665 tons, 8,000 horse power, and 21½ knots cost $837,500, while similar vessels in the British navy are built for $675,000—a difference of $162,500 in favor of the English builders. In connection with gunboats the difference is much more marked, the British vessels costing $200,000 less than the German gunboats, notwithstanding that the former, though 85 tons lighter, develop 2,300 more horse power and have a greater speed of 5¾ knots.

AN ELECTRIC ORE-REDUCING APPARATUS.

In order to facilitate the reduction of finely comminuted iron ore, it is necessary to agglomerate the ore into lumps of convenient size to be subsequently manipulated in the reducing furnace. Heretofore this has usually been done by mixing in some cementing medium and pressing this mixture into briquettes. However, this method is objectionable because the cement forms an additional impurity which must be subsequently eliminated. We illustrate herewith an apparatus invented by Mr. Marcus Ruthenburg, of Philadelphia, Pa., and which is calculated to accomplish the desired results without the use of any cementing material. The apparatus, which is mounted to swing over a series of soaking pits arranged in a circle about the supporting post, consists of a pair of carbon-faced bronze rolls slowly revolved by an electric motor through the intermediary of worm gearing. The frame on which the rolls are mounted consists of a heavy horseshoe magnet divided at the rear by an insulated hinge through which the supporting post passes. The magnet coils are wound on that portion of the magnet arms lying just back of the carbon-faced rolls. The poles, however, project within the rolls and are so shaped as to maintain an intense magnetic field between them at their line of nearest approach. The space between the rolls may be increased or decreased by operating the turnbuckle at the rear of the apparatus.

In operation the rolls are rotated toward each other at a rate of from one to four rotations per minute. The ore to be agglomerated is fed onto the rolls from an automatic feeder above, which is not shown in our illustration. The magnetic field serves to hold the ore from dropping off the rolls as they rotate, and in this position the ore forms an electric bridge of high resistance for a heavy current passed between the rolls. This serves to melt the ore and form it into lumps which drop into a soaking pit below. Four hundred and fifty kilowatt hours will melt one ton of product, or the continuous expenditure of 19 kilowatts will melt a ton in 24 hours. The rolls are water-cooled, so that the carbon-faces never become heated to a higher temperature than can be borne by the hand. Since the heat is engendered within the bridges, there is but little loss by radiation. Coal dust is usually mixed with the ore before it is introduced into the furnace so that a partial reduction takes place, and a further portion of oxygen is removed in the soaking pit, so that the product is then ready for melting in the open-hearth furnace as steel.



THE RUTHENBURG APPARATUS FOR AGGLOMERATING AND REDUCING IRON ORE.

All the trolley lines entering Cleveland, Ohio, have entered into an arrangement to engage in the freight and express business on a very extensive scale as direct competitors to the railroads of that vicinity. A large depot for the classification and handling of freight is being erected at a point in the city convenient to all the lines and it is expected that they will gather in a great deal of business. This method of handling the freight and express business has grown in such favor in some localities, particularly in the Middle West, that its merits are forcing themselves in those sections where the laws have heretofore protected the railroads. In Pennsylvania, for instance, there is talk of the introduction of a measure in the next legislature permitting electric transportation companies to engage in express or freight business, and although it will be bitterly fought by the railroad companies, the probabilities are the measure will become a law.

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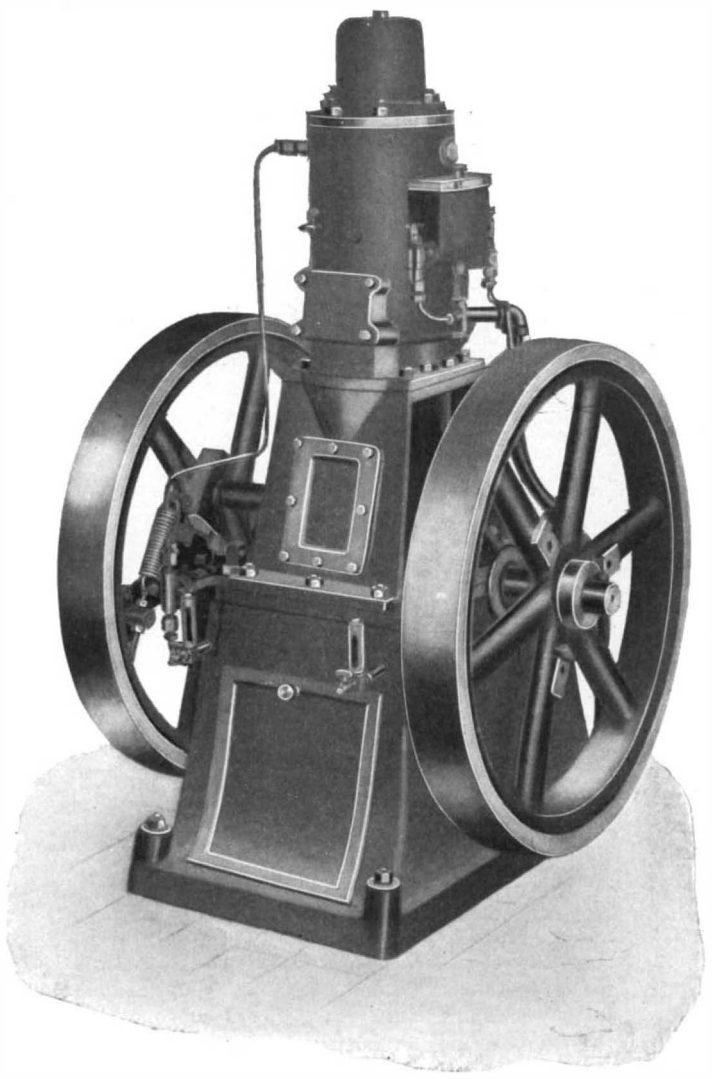
A SIMPLE KEROSENE ENGINE.

Considerable improvement has been made in the past few years in the utilization of kerosene oil as a motive power for combustion engines. Kerosene oil can be had almost anywhere, and on this account the problem of supplying a cheap small power is greatly simplified. Our illustrations show a new type of kerosene engine recently introduced, which has the merit of simplicity in a remarkable degree. It is of the two-cycle type, in which an explosion occurs in the cylinder at every revolution of the crankshaft; but its two most important features are that it operates without valves, and that the oil is forced by means of a small pump into the cylinder in the form of a spray through a suitable nozzle at the instant the piston begins to descend on its downward stroke, thereby avoiding premature explosions. Referring to the diagram, it will be noticed that the ignition is accomplished by the usual ignition hot tube or dome *D* at the upper end of the cylinder, the dome being protected by a damper cap to prevent heat radiation after the engine is started. A concentric cap fits over the inner cap. When both apertures coincide, the heating lamp for starting is placed inside; after starting, the outer cap is rotated till the apertures are covered.



A VALVELESS KEROSENE ENGINE.

The operation of the engine is as follows: the ignition dome *D* is heated for five minutes or more by a Primus kerosene blue-flame torch, then the handle of a small oil pump (seen on the left-hand side in the larger engraving) is operated a few times, to force the oil up from the tank *T* through the nozzle *O* into the cylinder *F*. One or two quick turns of the flywheel are given, then the engine starts.

On the up-stroke of the piston *P*, air is drawn in through two holes *A* in the base, and follows the piston through the port *B* into the crankcase *C* as soon as the piston uncovers the port. On its descent the piston slightly compresses this air in the crankcase until its upper end uncovers the exhaust *E* and also the air inlet *I*, then the exhaust gases pass out of *E*, and by the curved top of the piston the air from the crankcase is projected upward at the same time into the cylinder and locked there upon the upward stroke of the piston *P*, which closes the air inlet *I* and exhaust port *E*.

The air in the cylinder is then further compressed and heated by the continuation of the up-stroke of the piston, and just as the latter is about to descend a minute quantity of kerosene is injected by the oil feed pump and is immediately vaporized and mixed with the air, forming an explosive mixture that is in turn ignited by the hot dome *D*, the explosion driving the piston downward. The combustion is so perfect that the cylinder always remains clean and the piston is never clogged by soot. There is thus a positive entrance of the air and oil to the cylinder in regular sequence. *G* is an oil well for one of the main bearings, and *H* is a faucet for drawing off the oil collecting in the bottom of the crankcase.

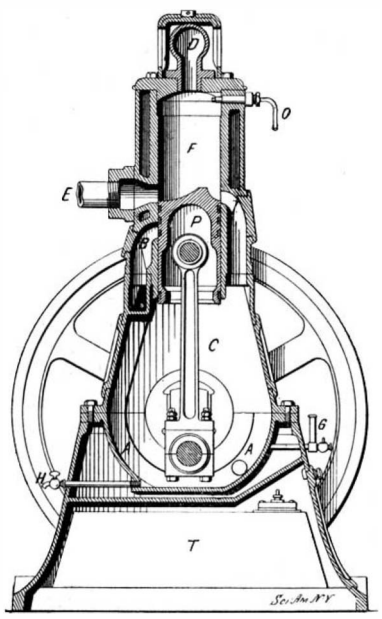
The tank containing the lubricating oil is located on the outside of the engine near the upper end, from which two small feed pipes lead, one for lubricating the cylinder, the other for the centrifugal oiler, which carries the oil through a small hole (not shown) in the center of the crankshaft to oil the crankpin. In this way oiling by the usual splash system is avoided.

The main-shaft bearings are fitted with the latest type of ring oilers, having glass cups, and it is said only require filling but once a month. The exhaust from the engine is smokeless and odorless, provided the right quantity of oil is used for lubrication.

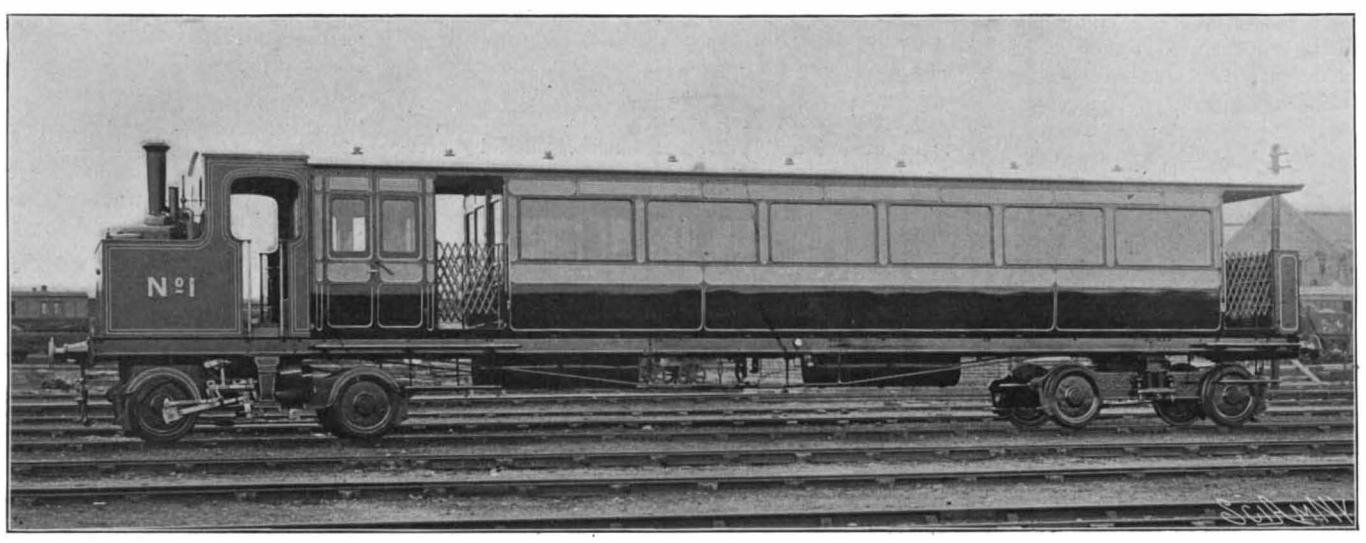
An eccentric on the main shaft with a variable throw, regulated by an exceedingly simple governor, changes the stroke of the oil-feed pump to suit the load. The engine responds very quickly to the varying quantities of fuel it receives, and the governing action is consequently positive and very close. This results in high efficiency, and makes it possible to obtain a brake horse power with 0.7 to 0.8 pound of oil, or a little less than a pint, which weighs about 0.85 pound. The Diesel engine, which is the most economical one made, consumes 0.45 to 0.55 pound of oil per brake horse power.

It will thus be seen that the American engine compares very favorably with it. When running with a three-quarters load, the engine consumes slightly less oil per horse power than when carrying a full load. In other words, it shows the highest efficiency at three-quarters load, and then requires a consumption of about one-tenth gallon of oil per horse power per hour. If stopped, the engine can be started within five minutes without reheating. We are advised that the engine has lately been introduced by the American and British Manufacturing Company, and is now manufactured at the Ordnance works of the company at Bridgeport, Conn.

The model we saw in operation showed fully five brake horse power, and easily carried a load of sixty 16 candle power incandescent electric lamps. The engine can be started to run in either direction as may be desired, and is so simple that it can be managed by a person of ordinary intelligence.



SECTIONAL ELEVATION OF KEROSENE ENGINE.



MOTOR COACH BUILT FOR THE LONDON AND SOUTH-WESTERN RAILWAY.

MOTOR COACHES FOR BRITISH RAILROADS.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Now that the automobile has asserted its superiority over other systems of rapid locomotion upon the highroads, and the engines for propelling the vehicles have been developed to a high standard of efficiency, the adaptation of the motor car to railroads is being seriously considered. In Great Britain several attempts are being made to introduce the motor-propelled vehicle upon certain branches of the railroads. Although the North-Eastern Railway Company was the first to decide upon the innovation, the first actual coach built upon these principles for use has been constructed conjointly by the London and South-Western Railroad and the London, Brighton, and South Coast Railroad, two trunk lines operating in the south of England.

The self-propelled motor coach possesses many advantages over the existing system for some phases of railroad working, the most obvious of which is its utilization as a feeder to the through lines. Some branch lines extending through sparsely-populated areas cannot be profitably operated, although a train service is absolutely necessary. It is for such exigencies that the self-propelled motor coach is peculiarly suitable, since the cost of maintenance is much less than that of a fully-equipped train.

The experimental coach constructed by the London and South-Western and the London, Brighton and South Coast Railroads, a photograph of which we are enabled to publish herewith through the courtesy of Mr. Drummond, the chief engineer to the former railroad, is intended for service between Fratton and Havant, a short line on the south coast joining the main trunk systems of the respective companies.

This coach consists of practically an ordinary passenger vehicle, with a small space allotted in the fore part for the accommodation of the motor. The latter in this instance is of the steam type. The coach is 56 feet in length over all, including the engine. It is carried upon two four-wheeled bogie trucks, the driving mechanism being attached to the two fore wheels of the front bogie. The passenger accommodation is divided into two compartments, one for first-class, and the other for third-class passengers. The compartment for the latter has a capacity for 32 passengers, the seats being arranged in the manner that prevails in American cars, on each side of the gangway, which extends through the center of the car. The first-class compartment is built to seat ten passengers, the seats in this instance being arranged longitudinally on either side of the car. Between the space reserved for the passengers and the motor is a small space for the conveyance of ten tons of baggage. The boiler, to economize space, is of the vertical type. The front pair of wheels of the fore bogie truck, as already stated, are the drivers, the cylinders being of 7-inch diameter and 10-inch stroke. A cab is provided for the engineer and his fireman. As will be recognized from our illustration, the motor has been compressed in as small a space as possible, and the general arrangement of the vehicle is very ingenious. The coach has been designed with the idea of attaining a speed of 30 miles an hour in half a minute after starting. There is no doubt that this class of self-propelled motor coach

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will prove profitable in its working, since it is of ample size to cope easily with the numbers of travelers requiring to journey over the few miles between Fratton and Havant at any time of the day. Should the coach prove successful, further vehicles of the same kind will be constructed for service upon other similar short sections of the railroads, and will in all probability be requisitioned for suburban traffic.

While the southern trunk railroads have adopted the steam motor for these automotor coaches, the North-Eastern Railroad has decided to utilize the petrol motor for the same purpose and is carrying out a series of experiments with various types of motors, to ascertain which is the best suited to their requirements. Orders have been placed with the Wolseley Motor Company, of Birmingham, and the Napier Motor Car Company, of London. The former company is building two motors, each to develop 95 horse on the brake. They are of the horizontal type, while the Napier belong to the vertical category, though it is anticipated for this class of work that the former will prove more satisfactory. These engines have not yet been completed, so we are unable to publish a photograph of the petrol-propelled coach.

The cars measure 53 feet, 3 inches from buffer to buffer, and the greatest width is 9 feet, 6 inches over balks. It is carried on two four-wheeled bogie trucks, the distance between which from center to center is 34 feet. The wheels are of 3 feet, 6 inches diameter over treads, and are provided with the usual type of axle-boxes, springs, etc.

The third-class coach is designed to carry 48 passengers, while the first and second class composite vehicle has accommodation for 14 and 24 passengers respectively. In the front of the coach is the compartment for the petrol motor, which is direct-coupled to an electric generator mounted on one baseplate. This compartment also contains a small exciting dynamo for exciting the fields of the generator, and for charging a small battery of accumulators for lighting, etc. This battery is contained in a suitable box slung beneath the frame in the center of the coach. The engine compartment also contains one complete set of control apparatus—controllers, regulating resistances, and switches—for driving the car, for driving the coach forward, while another set is installed at the other end of the coach for driving in the opposite direction. Each bogie is fitted with a powerful electric railroad motor.

The prime motor is a Wolseley 80 horse power four-cylinder petrol engine of standard type. The four cylinders are each 8½-inch bore by 10-inch stroke, giving 81 brake horse power at 420 revolutions, and with an acceleration up to 480 revolutions the engine gives 95 brake horse power. The cylinders work in pairs on two crankpins at 180 degrees from each other, thus obtaining two impulses at every revolution. The electric generator is of 60-kilowatt capacity, 500 volts, at 450 revolutions per minute, with a 5-kilowatt exciter. An electric railway motor of 50 horse power is mounted on each of the two bogies. There is a battery of 40 accumulators carried beneath the coach, of about 90 amperes capacity, for lighting and starting the petrol engine through the exciter. The choking and accelerating levers, and all controlling apparatus for the engine room and dynamo, are conveniently situated in the engine room. The necessary gear, such as brakes, controllers, etc., for driving the coach is installed in duplicate, one set at each end of the car, to enable the driver to occupy the front of the car when going either way.

The Westinghouse automatic air brake is installed, acting on all wheels, the air compressor being driven by a small electric motor. Powerful screw compensated hand brakes are also provided, a brake wheel being fixed at each end of the coach for its operation. A siren is fitted to each coach, operated by compressed air from the Westinghouse brake reservoir. Petrol and water tanks are provided of sufficient capacity to enable the car to run continuously for five hours at speeds up to 30 miles per hour. Ample silencers and exhaust boxes are also provided.

THE COAL INDUSTRY OF PENNSYLVANIA.

BY W. FRANK M'CLURE.

Five years ago Great Britain produced more coal than America or any other country of the globe. Since that time the United States in one year has mined 25,000,000 tons more than Great Britain and all her possessions. This is one of four important facts peculiar at this time to American coal mining. The other three are found in the development of the vast Southern resources, the combining of mining properties, and an evolution of the industry.

The development of the Southern fields gives some promise that the United States will yet become an important exporter of coal. The numerous consolidations of mining properties are believed to be the first steps toward another such giant combination as that represented by the United States Steel Corporation in the world of iron and steel.

Since surpassing England, the United States has not only maintained her prestige, but has increased it. The annual output has grown nearly one-half in five years, and is now figured at one-third that of the world. While there is an end in sight to England's coal, in America there is no visible end except to Pennsylvania anthracite. The annual American production now exceeds 293,000,000 tons, of which more than 225,000,000 tons are bituminous. To dig out this coal nearly a half million men are employed, of whom less than 150,000 are engaged in the famous hard-coal regions, which are located in Pennsylvania save very small beds in New Mexico and Colorado.

Five hundred or more feet beneath the surface of the ground of the anthracite or bituminous regions of Pennsylvania there exist many busy mining centers. So varied is the topography of the coal regions, and so different are the conditions and the necessities in the different localities, that no description of the construction of mines and methods of mining and transportation can be true of all mines, even though of the same type. The mines pictured on another page are of the shaft type, and are to be found in largest numbers in the hard-coal districts. The hard-coal mines are likewise the deepest. Occasionally an extreme depth of 1,500 feet is attained. The mine foreman's office, which is shown in the illustration, is 550 feet beneath the surface in the soft-coal fields of the Connellsville regions. The mine in which this view was taken is owned by the United States Steel Corporation, and is the deepest one in that section of the State.

Incidentally, there are two other styles of mines to be found in both anthracite and bituminous fields—"drifts" and "slopes." The drift mine is dug straight into the mountain from one side. The passageway or heading may have an upward trend. The slope mine slants downward to the extent of perhaps thirty-five or forty degrees, the main heading often measuring a mile or more in length.

Occasionally coal is found in quantities near the surface of the ground. This is true to-day in parts of Missouri. At both Hazelton and Summit Hill, in Pennsylvania, coal has been extracted by an uncovering operation known as "stripping," and which is regarded as apart from mining proper. An interesting process also is "pocket mining," but this is practised comparatively little to-day. An outcrop of coal at various points on the side of the mountain suggests the possibility of a rich mineral vein. Digging is begun directly into the bed of coal projecting at the surface. This form of mining is seldom highly profitable, for when the digging has progressed at considerable expense to a point where the mine should be expected to pay, all operations are suddenly cut short by the encountering of solid rock, which, owing to some upheaval of the past, has "faulted" the vein of coal from its natural course. These pockets at intervals in the mountains where pocket mining is done present an interesting sight. About Shickshinny, Pa., they are numerous.

Descending by means of an elevator into the depth of the soft-coal mine before mentioned, we find ourselves in front of a whitewashed haulageway which extends far into the distance. The mine is a strictly modern one. Nearby we find a door leading into the mine foreman's office, and this in turn connects with the office of the fire boss. The foreman sits at his desk in the midst of mine reports and books of rules. Like the miners in the distant rooms, he is breathing fresh air, made possible at this depth by an air course which parallels the elevator shaft, the bad air being drawn out by means of fans, while the pure air rushes down the shaft to take its place. In close proximity to the foot of the elevator shaft are the stables of the mules, and these are likewise whitewashed. The mules in such a mine as this do not see daylight for months at a time. The haulageway, the offices, and the stables are lighted by electricity.

In shaft mines, and especially those of anthracite, mules are used very extensively. Where mechanical power is employed to haul trains in the main haulageways, these beasts bring the cars only from the side headings or the rooms. In bituminous drift mines the evolution has included the introduction of miniature trolley trains of forty or fifty cars, each train being in charge of a motorman and brakeman. In anthracite drifts steam locomotives of a small and peculiar type known as "hogs" haul the trains. In a slope mine cable trains transport the coal. One end of the cable is attached to the train, and the other winds upon a drum at the power house. When the cable turns a corner it passes around what is known as a "bull wheel." Twenty-five one-ton cars may comprise a cable train of soft coal. Anthracite cars often hold four and a half tons. In soft-coal mines the man in charge of the cable train is called a "rope rider." In bringing his cars out of the mine he sits upon the ring which connects the cable with the train. In the anthracite slopes a man stands upon the side of a car ready to "sprag" the wheels when a stop is made. Spragging consists in throwing short but stout lengths of wood into the openings between the four spokes of the car wheel.

The differences in the modern soft-coal mine and the anthracite mine are very perceptible. It has been found impossible to employ electrical machinery and mechanical inventions in the actual mining operations in anthracite. Therefore picks and hand drills with blasting powder are still the mainstay of the anthracite miners, and the 4,000 machines in use in the United States are all at work in soft coal. More than fifty per cent of the big increase in bituminous coal production in the past few years is accounted for by the rapid introduction of machines. They are now in use in half the States and Territories. One-third of the bituminous product of Pennsylvania is mined by their aid. These machines make the undercut that is to loosen the coal at the bottom. They cut as far back as the vein is high. The blade, which is four to six feet in length, severs the block of coal at the bottom and drills bore holes horizontally at the top. Powder is crowded into these holes and a fuse, or squib, is lighted. Blasting operations are similar in the anthracite regions. There, however, the miner may break down enough coal at one blast to keep his helper busy loading for two days.

The photograph of the room in the hard-coal mine illustrates nicely the great height of the veins of coal in the anthracite districts. The height of the bituminous vein is often not more than four or five feet, thus making the quarters of the miners rather cramped. In the mining of anthracite only two-thirds loosened from the vein is of value. The miner must use good judgment in loading only the paying coal. To handle and transport chunks in which slate predominates is unprofitable. Even the better coal has more or less slate in it, while in bituminous coal the slate is principally at the top and bottom of the vein and not mixed with the product as mined.

Off from the main or side headings of a hard-coal mine "breasts" or "chambers" are opened. In bituminous fields these are known as "rooms." A tunnel or neck forty to sixty feet long may connect the room proper with the main passageway. Beyond the neck the chamber may broaden out to a width of thirty or more feet, continuing indefinitely. The coal between the rooms forms what is known as a "rib" or "pillar." As the rooms begin to broaden to their maximum widths, timber props are placed between the floors and ceilings to support the loose rock and earth. Apart from supporting the great mass of solid rock, they are of little service.

When all the coal that it is practical to mine in the chambers has been extracted, the work of drawing the ribs between the rooms is begun, eventually allowing the rock above to cave in. In addition to securing the coal in the ribs, this process is necessary, that the weight of the mountain bearing upon the entrance to the mine may be lightened. As mining progresses, the weight is thrown upon the main heading, until, were it not for the drawing of the ribs, this main passageway would close.

When drawing a rib, the soft-coal miner keeps but one car beside him. He can not tell how much of the rib he will be able to remove before the rock above his head will fall. The first warning of approaching danger is a drumming noise from the layer of stone overhead. Sometimes this noise may be heard hours before the final crash; in anthracite mines it may be perhaps weeks before. Again, it may come with marked suddenness.

The coal breaker, about which the public has heard not a little during the last big coal strike, is an anthracite institution. The breaker is mentioned perhaps oftener than some other important plants chiefly because of the tender ages of the thousands of workers employed within them. The character of anthracite coal as mined makes it imperative that the breaking of it shall comprise a branch of the coal industry. The large chunks must be broken and the slate must be separated.

A modern coal breaker built on the side of a hill at Mocanaqua, Pa., will serve to illustrate the construction and operations connected with this important branch of producing coal. This breaker is 300 feet in length and 180 feet in height. Ten tons of spikes and nails were used in its construction. It is capable of turning out 1,000 tons of clean coal per day. Some breakers have a capacity several hundred tons more. The Mocanaqua breaker was originally built at a cost of $50,000, but with recent improvements and the installation of the latest machinery its total cost reaches $100,000. It is heated by steam.

Two 4½-ton cars of anthracite are brought to the head of the breaker at one time over a little railway leading from the mine in the side of the mountain. The coal when dumped from the cars passes over a screen thirty feet in length, through which the fine coal sifts. The big chunks next pass to the breaker proper, where the rolls crush it until none of the

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product is larger than what is known as "steamboat size." It next runs into a screen which is cylindrical in shape, and not unlike a locomotive boiler in appearance. As the coal is handled in this device, it falls through perforations of different sizes, each size dropping into a separate chute. On benches at intervals on these chutes, sit the breaker boys, presided over by a boss. As the coal passes slowly down the chute at their feet, these lads pick the slate from it and throw the refuse into a parallel chute. The inexperienced boys are always at the upper end of the chutes. They succeed in picking a part of the slate from the coal, and then it passes to the next workmen in line, who continue the operation until, by the time the product has reached the last boys in the rows—the ones at the bottom of the chutes—it is pretty well cleaned. From the chutes the various sized coal finds its way into bins, from which it is discharged into cars.

It is said to be difficult nowadays to find as many breaker boys as are needed, and, partly on this account, mechanical contrivances for sorting have recently been installed at great cost in modern breakers. These inventions are spiral in shape, and provide for ridding the coal of much of its slate by centrifugal force. But even with these machines the final operation must be performed by boys or men.

A large amount of the soft coal in Ohio and Pennsylvania is brought to the lower harbors of the Great Lakes, bound for the Northwest and Canada. The cars which carry this coal have a capacity of 100,000 pounds, whereas, in the early days of the coal industry in this country, coal cars scarce carried 1,800 pounds. On reaching the lake ports, coal for Canada may be taken sixty miles across Lake Erie in car ferries. But the bulk of the coal that comes to the lake ports is unloaded directly into the holds of lake vessels by means of most wonderful and massive machines, which pick up a 50-ton car and dump its contents as quickly as a pail of coal could be emptied into the magazine of a stove. Some of these machines can be operated by three men, and yet have a capacity of 500 tons per hour. A large and modern coal vessel will carry a coal cargo of 6,000 tons. The cargo record is 7,800 tons. More than 2,500,000 tons of coal have gone to the head of the Great Lakes in a single season.

Marconi's Recognition of Italy's Services.

The large rentals and heavy royalties demanded by the Marconi Company are said to be the chief reasons why the United States government has decided to adopt the Slaby-Arco or some other system. It is interesting, therefore, to note that Mr. Marconi is not quite as selfish as the reports which have been circulated would seem to indicate. He has ceded his apparatus to the Italian government, free of charge, giving permission to have it reproduced in military establishments, provided that his patents be not infringed. It is said that twelve wireless telegraph stations will be established on the coast and on the islands off the Italian coast, each station having an average range of about 200 miles. Some of the stations are to be completed before the end of the present year, and the others within the first six months of 1904. The arrangement as to rates deserves some attention.

The receipts from telegrams sent from stations on the Italian coast will be paid into the government treasury; the receipts from mesages sent from ships equipped with the Marconi apparatus will go to the Marçoni company, and finally, the Italian government will receive a fixed tax of one lire per message above the ordinary cost of telegrams.

The Use of Phosphorus Matches Prohibited in Germany.

The Reichstag has passed a bill forbidding the use of white or yellow phosphorus in match-making after January 1, 1908. The Secretary of the Interior, speaking in favor of the bill, said that phosphorus not only caused necrosis three or four years after a workman had left a match factory, but that the disease thus contracted was hereditary, so that whole families were affected. So subtle were the effects, that the bones were fractured without the person being even aware of the fracture at first. The government has reported favorably upon a match-manufacturing process said to be safe and harmless.

On May 9, the largest glass bottles even blown were made at the plant of the Illinois Glass Company for exhibition at the World's Fair. The capacity of each bottle is 45 gallons. It was not until after many unsuccessful attempts that the bottles were made. Four perfect bottles were produced. Each stands nearly 6 feet high and measures about 16 inches across the bottom. The men who blew the bottles each supplied **about 11,000 cubic inches of air.**

Engineering Notes.

It is likely that a system of power fans will be used to ventilate the New York subway when it is completed. The problem, however, of suitably ventilating the subway will not be formidable, for the reason that the stations are close to the surface of the ground. In this respect the New York system will differ widely from that of London, where the tubes are so far underground that the air quickly becomes vitiated.

A great pumping scheme is to be carried out in South Staffordshire, England, by means of which over 40,000,000 tons of coal which are at present submerged will be released and rendered available for mining. The district in which the scheme is to be carried out includes the important industrial centers of Tipton, Wednesbury, and Bilston. The project has been contemplated for many years past, but it is only recently that the scheme has been reduced to any practical form.

His Majesty's battleship "Hood" arrived at Devonport recently after steaming from Malta, a distance of 2,035 miles, without a rudder. On docking at Malta it was found that the rudder could not be satisfactorily repaired, and that it would be necessary to fit a new one, which must be cast in England. The disabled rudder, weighing fifteen tons, was accordingly hoisted on board and lashed fast on the deck, and on October 21 the "Hood" left Malta rudderless, arriving at Gibraltar on October 24, having done 981 miles at an average speed of twelve and a half knots an hour. Leaving the Rock on the following day in a strong northeasterly gale she ran into a fog on the last day of her voyage (Tuesday), but ultimately reached Plymouth the same evening, having made the 2,035 miles in a little over six days, or at an average speed of nearly thirteen knots an hour. This would be a good performance for any battleship under normal circumstances, but for a vessel without a rudder in a heavy sea, continually being twisted round out of her course, it is a feat of seamanship reflecting the greatest credit on her officers. It should be added that the "Hood" was convoyed by cruisers.

In these days of high coal prices and strikes, it is interesting to know that peat gas has been employed as fuel at the Motala Steel Works, Sweden, for the past thirty years, originally for the puddling furnaces, and to a still greater extent, subsequently, for the open-hearth furnaces. The peat is obtained from the further side of Lake Wetter, across which it is brought in sailing vessels and unloaded directly into large storehouses, whence it is trammed to the gas producers. The yearly consumption is from 13,000 to 16,000 cubic yards of dry kneaded peat, costing about 75 cents per cubic yard delivered at Motala. Two large gas producers are used, from which the gas is led to the open-hearth furnaces through a condenser for ridding it of some of its moisture. Although the peat gas, owing to the distance the peat has to be brought, is dearer than coal gas, it is used preferably in most Swedish steel works in consequence of the insignificant amount of sulphur and phosphorus it contains. In the rolling mill there is a smaller peat-gas producer for one of the plate furnaces, and thin steel plates especially scale less in rolling when the furnace is fired with peat gas.

The designs of the Quetta Nushki Railroad in Persia as a light road capable of being brought up to the standard of other frontier railways, when the circumstances so demand, have been completed and accepted by the government of India. The length of the line is 82½ miles, and the estimated cost is about 7,000,000 rupees, or 85,000 rupees per mile. The route selected for the construction of the track involves passing through three mountain barriers, viz., the Chiltan, the Mashelak, and the southern tail of the Khwaja Amran range, which separates the Quetta plateau from the Nushki plain, by the intermediate steppes of the Mastung and Sharud plains. The road leaves the existing Bolan section of the Northwestern Railway twelve miles from Quetta, and three from Spezand Station. Through the three mountain ridges the work is heavy, and a good permanent foundation is provided for. Otherwise the country is comparatively easy, and a surface track only, capable of improvement later on, is at present intended. The steepest grades are 1 in 50, compensated for curvature, and the sharpest curve has a 573-foot radius. A tunnel at Spezand is to be built, 2,600 feet long, five miles from the commencement, and the heavy works in the Sheikh Wasil gorge, miles 27 to 32, are to be put in hand at a cost of about 4,750,000 rupees during the current financial year, and work on them will be commenced at once. These are the only heavy works in the first 50 miles; and as soon as they are negotiated there will be no further difficulty in at once carrying out the road to that distance. This will give immediate access to the Sharud plain, and will enable the entire line to be completed with speed and economy. This railroad will not only be an important one from a commercial point of view, **but is also of great political significance.**

Electrical Notes.

During a research into the electro-chemical behavior of sulphur Mr. F. W. Küster has observed that during the electrolysis of a solution of a polysulphide, both the current and the voltage undergo periodic variations, which are shown to be due to the deposition of sulphur on the anode. The periodicity of the phenomenon is, however, difficult to understand. In order to throw light on this, a number of measurements of the potential differences between electrodes of platinum or of silver and solutions of sodium polysulphides were made. The results show that such electrodes may be regarded as sulphur electrodes, just as a platinum plate saturated with oxygen may be regarded as an oxygen electrode.

When we consider what an important adjunct the telegraph has become to the railroad, says The Electrical World and Engineer, it is hard to get one's self back to the time of the Baltimore & Ohio experiments of 1844, and to take seriously Prof. Morse's suggestion that if a break were found in the telegraph wire, the train should stop long enough to repair it. But this is what he said: "Very little interruption would take place if the train that discovered a break would stop not more than five minutes, and, being furnished with pieces of wire already prepared for the purpose, any one could simply unwrap and scrape the broken ends and unite them by twisting the ends of the pieces of wire to them."

This country is rapidly becoming the center for the manufacture of cables for underground telephonic communication over long distances. The reason for this is not due to any economical or other aspects in the actual manufacture, but is entirely the result of atmospheric influences. One of the greatest difficulties that confronts the problem of telephone practice over long distances in England, is the provision of satisfactory insulating material. All insulating substances at present utilized in the manufacture of cables absorb the electric current to a certain degree. The extent of this absorption depends upon two factors—the nature of the dielectric employed and the potential of the current transmitted through the wire. In the cases of high-tension currents the leakage in this direction is so small as not to be worthy of notice, but in the case of a telephone cable, where the potential of the current is very low, this absorption is a matter of grave importance. So far the best dielectric yet discovered is anhydrous paper, which is extensively adopted in England. This substance has the lowest specific inductive capacity of any known dielectric. In order that cables composed of anhydrous paper may be rendered absolutely trustworthy and satisfactory, it is imperative that the process of manufacture should be carried out in a perfectly dry atmosphere. Should the paper come into contact with moisture at any time during the making, its future good working will be absolutely nullified. In Great Britain, owing to the natural humidity of the atmosphere, it is absolutely impossible to manufacture the material; while in this country, owing to much drier atmospheric conditions, we are enabled to turn out a perfect article. Consequently, the industry has fallen into desuetude in Great Britain, while this country is becoming the center of the supply.

M. S. Leduc recently explained before the Academy of Sciences in Paris his method of inducing sleep and anæsthesia by electrical currents. He employs an interrupted current in a low-resistance circuit, and sleep is induced by gradually augmenting the E. M. F. in the circuit. From further information we have received it seems that the frequency of the current used is from 150 to 200 periods per second. Besides the interrupter, there is also placed in the circuit a milliampere meter, the period of oscillation of which is much longer than the duration of the interruption of the current. Under these conditions, when the instrument is traversed by an intermittent current the needle undergoes a permanent deviation, which enables the intensity of the currents having the same intermittence and the same duration to be compared. Leduc has experimented with currents of varying degrees of intensity, but those which gave the best results had from 150 to 200 intermittences in the second with a tension of from 12 to 30 volts. The cathode is made of hydrophilous cotton impregnated with a solution of sodium chloride of the strength of 0.60 per cent, and covering with a plate of metal. This is placed on the shaven head of the animal to be experimented on, while the anode is placed on the hinder part of the back, which is also shaved. The E. M. F. is increased till convulsions take place, and the animal falls on its side and respiration ceases. The handle of the regulator is then brought backward till respiration returns, and with a certain strength of current, tranquil, ordinary sleep is induced. The duration of the sleep is variable, in many instances lasting for two hours or more without any ill effects upon the subject. The return of consciousness is effected by the removal of the current, **and no injurious consequences are said to follow.**

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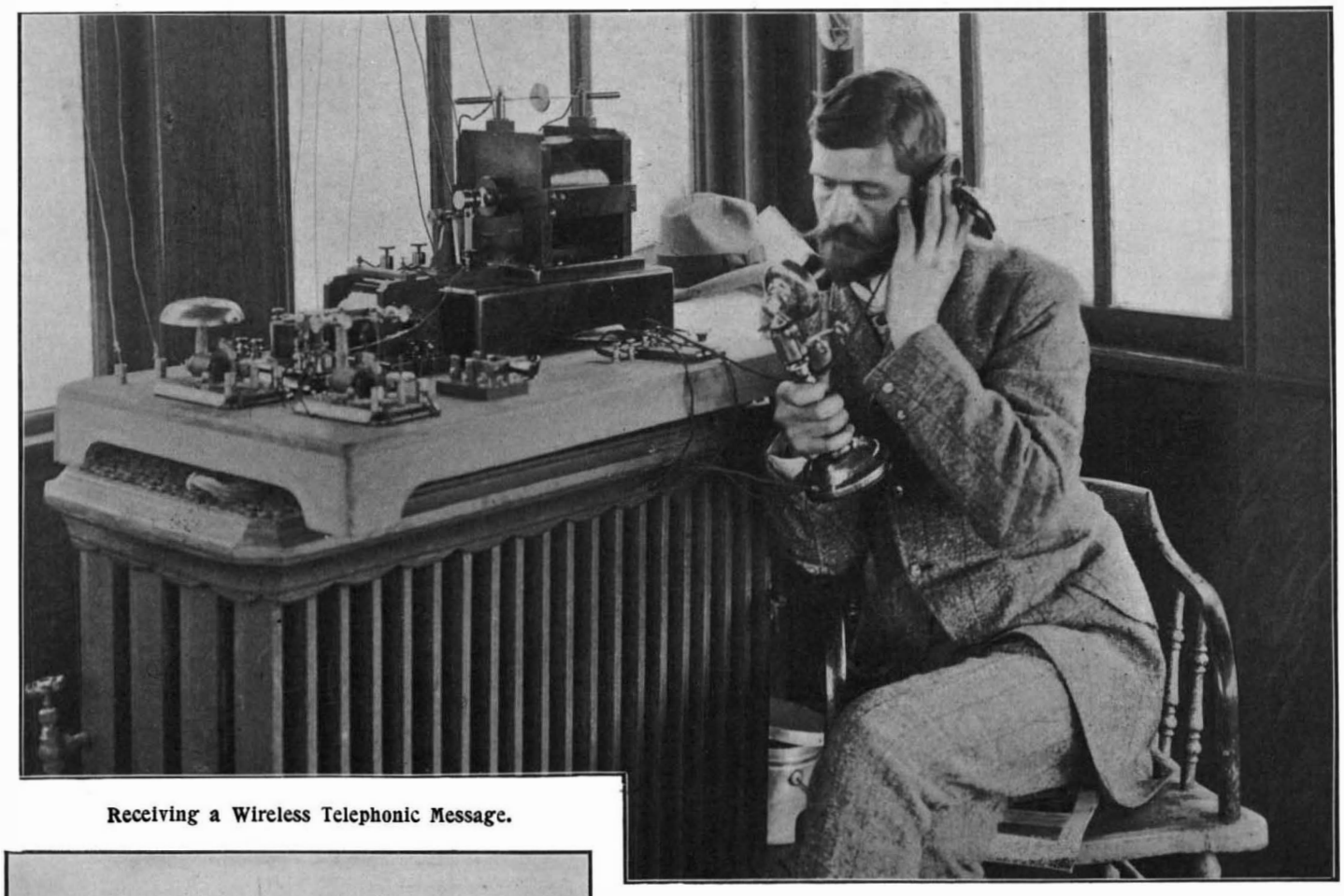
WIRELESS TELEPHONIC COMMUNICATION BETWEEN MOVING FERRY BOATS.

BY DR. T. BYARD COLLINS.

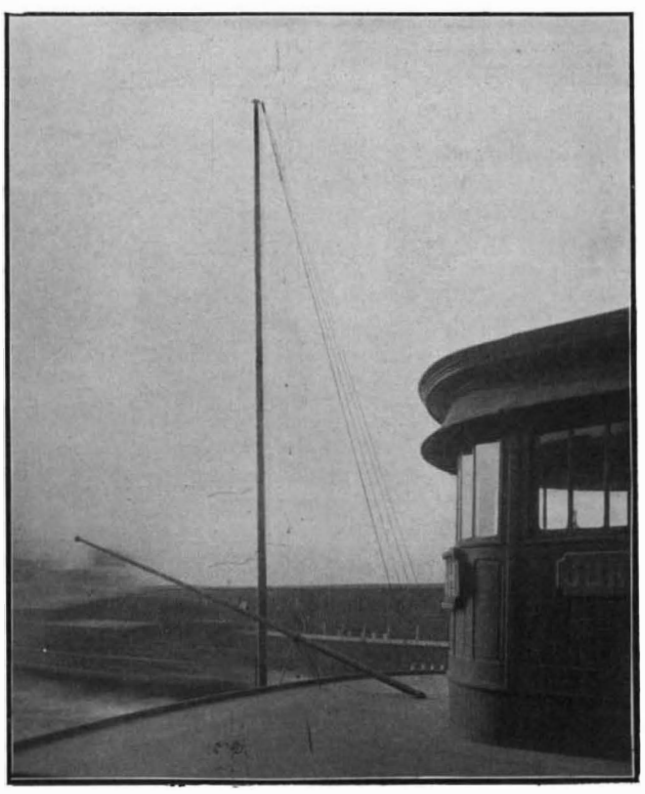
The electrical transmission of speech to a distance without the intervention of wires was given a commercial test last week when Mr. A. Frederick Collins telephoned between two ferry boats which were moving in opposite directions on the North River between Jersey City and New York.

The test was the culmination of a long series of experiments begun three years ago at Narberth, Pa., and continued to the present time. During the past summer Congers and Rockland Lake, N. Y., served as a proving ground, but during the winter Mr. Collins transferred the scenes of his activity to this city. In April, he proposed to the officials of the Erie R. R. to apply his system to the boats of their ferry. Mr. Collins was given every facility to carry out his plans. He made a beginning by carefully studying the needs of the service in this regard and by thoroughly inspecting the conditions under which he would have to work. He learned that there were, as regards the ferry boats at least, two kinds of bottoms, iron and wooden; but the wooden bottoms, while rendering it easy to attach the contact plates which are a part of the system, were surrounded at the water line by a continuous sheathing of copper 36 inches wide. Deeming it possible that the lines of force might be carried around this conductor instead of being propagated as the successful working of the apparatus requires, he decided to use the iron bottoms, though this would involve the use of other means of contact than the securing of the plates to the boats' hulls. There was also an uncertainty as to what effect this immense mass of metal would have in deflecting the current from the desired direction. Mr. Collins was working under absolutely new conditions. Experience proved that the iron bottoms held no inherent difficulties for wireless telephony; but an unexpected difficulty arose indirectly on their account. In Mr. Collins' system the contact with the water should be made by means of copper or zinc plates each having a surface of several square feet. It being impractical to have the boats laid up in drydock for the purpose of attaching such plates to the boats' bottoms, it was at first thought feasible to attach the plates to their wires and throw them overboard; but greatly to the surprise of everybody concerned, though the plates weighed ten pounds apiece, they were prevented from sinking by the rapid movement of the boat. In consequence, the contact pieces were finally replaced by a few inches of heavy copper tubing which was let down the rain pipes to the water. The tubes danced upon the surface of the water as the plates had done, the circuit was repeatedly broken, and at no time did they make a really satisfactory contact with the element.

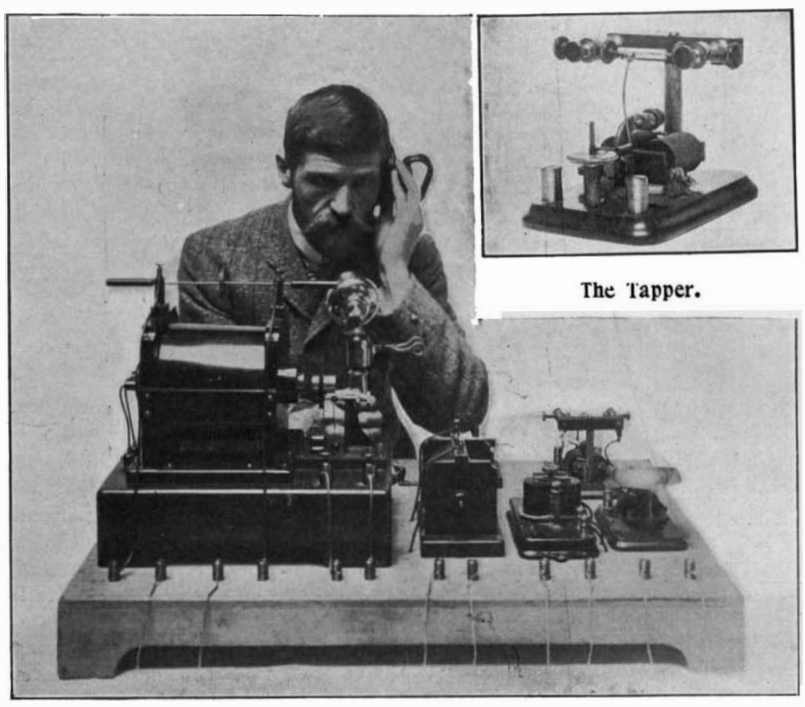
In general it may be said that the system consists in antennæ as in wireless telegraphy, earth plates—i. e., water contacts—the transmitting apparatus and the receiving instruments, all of which have been carefully written up by Mr. Collins himself and published in the SCIENTIFIC AMERICAN of July 18, 1902. The flagstaffs at the vessels' prows served admirably as masts for the antennæ and the steam radiators in the pilot houses answered for tables upon which to place the sending and receiving instruments. A battery of fifty cells, placed just outside the pilot house, furnished the current.



Receiving a Wireless Telephonic Message.



The Pilot-House Deck, Showing the Flagstaff Used as a Mast for Antennae.



General View of the Transmitting Apparatus.

The Tapper.

MR. A. F. COLLINS' WIRELESS TELEPHONE EXPERIMENTS.

On Friday, May 8, everything was in readiness. Mr. Collins took his stand in the pilot house of the "John G. McCullah," where the transmitting instruments were installed. The writer and several other gentlemen were in the corresponding location on the "Ridgewood" with the receiving device. As the boats approached within five hundred feet of each other the voice of Mr. Collins was distinctly heard. "Hello, hello. This is the Collins wireless telephone. Do you hear what I say? One, two, three, four, five. That's all. Good-bye." The following day—the 9th—the first public demonstration was given and amid the usual harbor and river sounds—the tug and other whistles, the swish of waters, etc.—the articulations of Mr. Collins' voice came over distinctly from the "McCullah" to the "Ridgewood."

The contact with the water, as before mentioned, was neither sufficient nor constant and the current used was inadequate. In permanent installations there will be no difficulty in attaching the plates to the hulls. Where a strip of copper surrounds the boat a vertical slit would be made through the copper on either side and then each half would serve as a contact plate, it being necessary in such case only to make the proper connection.

For current, the cells would be discarded. Either a transformer employed in connection with the boat's dynamo or a motor generator set will be used.

Two or three questions suggested themselves to those who witnessed the performance. "How far can you telephone by this system?" "Why isn't the wireless telegraph better for this purpose?"

When the experiments were being conducted at Congers the writer heard articulate speech distinctly over a distance of 6,000 feet. In the harbor, where the conditions are all different, Mr. Collins will only state at present that he can cover 1,000 feet. But as he and others have pointed out, for harbor and river purposes it is not great distances which are called for. Boats do not ram each other at great distances. In the uncertainties of a blinding snowstorm or during a dense fog when the pilot cannot see the prow of his own boat, if he could telephone the vessel nearest to him, though he could only learn her name and the direction in which she was going he would be greatly assisted; but when he might learn also where she stood by the compass, the one could steer a few points to the right, the other a few points to the left, and the sickening disasters with their losses of human life which occur time and again in every harbor would be largely avoided. The wireless telegraph has its place but it is not on harbor and river craft. Like any other telegraph, the wireless needs an operator. That means that an extra man would have to be employed and placed in the pilot house, which, with what it already contains, is none too large. Moreover, in the terrible uncertainties of thick weather there is no time to wait for the translation of messages—the pilot has no time for second-hand communications.

As yet, the instruments of the wireless telephone are not synchronized, but neither are they in wireless telegraphy. Besides, the telephone for ferries and other harbor craft is not for social purposes; it is for exigencies. Secrecy is of no importance here. The steam whistle is not synchronized, but its sounds have been of incalculable service, notwithstanding.

Captains of tug, ferry and other boats point out many uses for the wireless telephone which one un-

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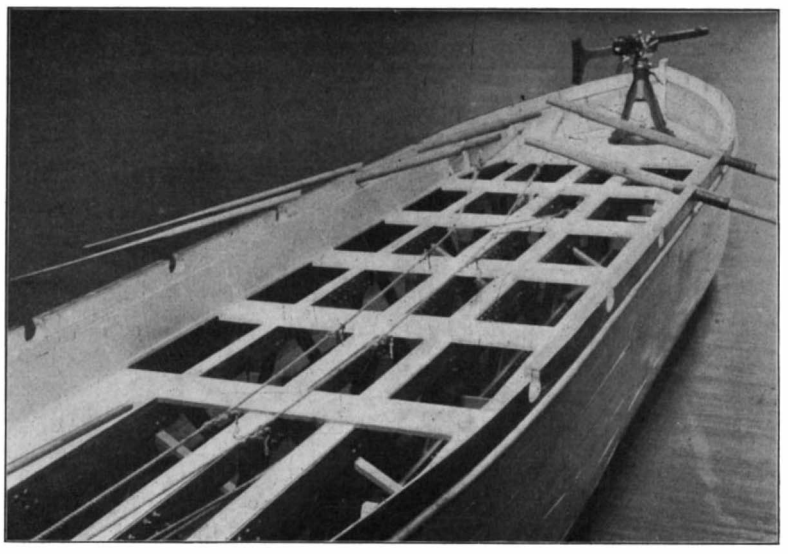
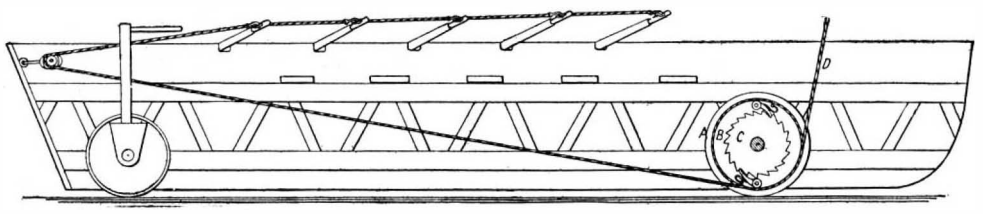
familiar with the river and harbor service would never think of, and all are enthusiastic over its advent as a time saver, a money maker and a relief of the terrible responsibility for the precious lives entrusted to them in heavy weather.

A LAND BOAT FOR ARMORY USE.

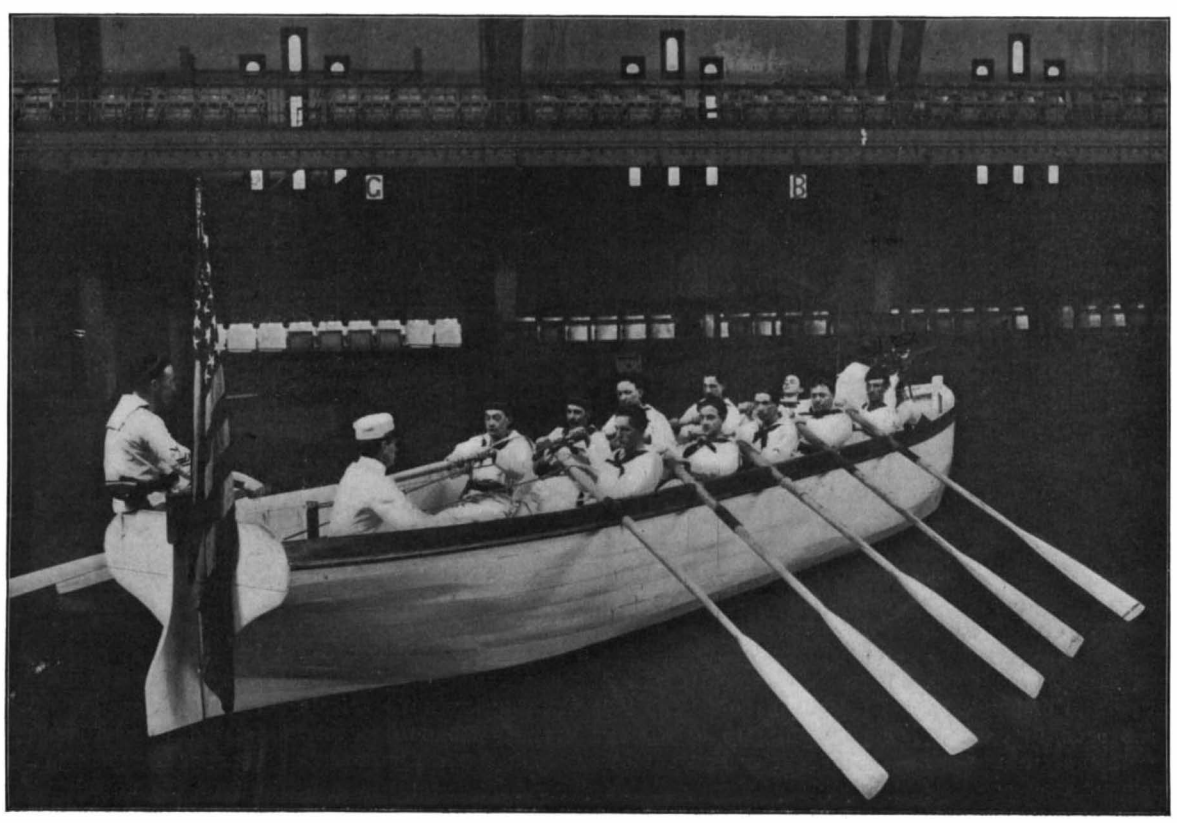
In the exhibition drill given at the Armory of the Thirteenth Regiment, N. G. N. Y., following the review by Lt.-Col. Spicer, U. S. M. C., of a battalion composed of a battery from the Second Battalion, Naval Militia, New York, and Company D of the regiment, a novel form of boat was used. A fort had been constructed around the 8-inch disappearing gun used by the regiment, and a range station was built on the parapet. In the opposite corner of the armory, the bow of a battleship projected out onto the floor. The armory being darkened, a boat appeared from behind the ship and dashed across the floor, containing a landing party, who were to attack and destroy the range station. Being discovered by an alert sentry, a searchlight was turned on and the alarm given. The long roll called the artillerymen to their posts, but before they could locate the attack, the boat had landed its party, the wall had been scaled, and a bomb placed in the station and the boat regained, the dead and wounded being carried off on the shoulders of the survivors. The fire of the sentries during the attack was answered by a one-pounder mounted in the bow of the cutter. After the boat disappeared in the darkness, the battleship was discovered by the searchlight, and its magazine reached by a well-directed shot from the 8-inch gun. The boat, which is modeled on the lines of a regulation navy cutter, is 30 feet long and 6 feet beam, carrying a crew of ten men at the oars, a gun crew forward and a coxswain and commissioned officer aft. It is cut off at the waterline, and all mechanism being inside, the effect is that of a boat gliding through still water, and under the beam of the searchlight, is very realistic. A 2½-inch shaft under the forward thwart has an iron wheel, *A*, keyed to it on either end. In the center is keyed a drum, *C*, with ratchet teeth on its circumference, and engaging these teeth is a pawl carried by a sleeve which turns on the drum. Around the sleeve, and leading clear aft through a snatchblock back to the handles of the oars, is a manila line. When the men give way, the line turns the sleeve, the pawl engages the teeth on the drum, the shaft and with it the wheels turn, and the boat goes ahead. On recovering from the stroke, a line, *D*, leading from the oars forward returns the ratchet to position, and the operation is repeated indefinitely. As far aft as it could be placed without interfering with the lines of the boat, is placed a single wheel, and a rudder post rising from this controls the steering, the whole method of support and steering being similar to an iceboat. The weight of the gun, boat, and crew, amounting to about two tons, is carried by four wooden trusses running fore and aft, two close together and two as near the sides as they could be placed. The thwarts, gunwale, rowlocks, etc., are standard. The hauling line is equipped with snaphooks and the oars with screw-eyes, so the line can be quickly detached from the oars. The men toss, boat the oars, up oars, let fall, give way, etc. just as they would afloat, and the Second Naval Battalion will use the boat for winter indoor instruction in their new armory, foot of 52d Street, Brooklyn. The boat was designed by Lieut. Kingsley L. Martin, commanding the second division of the battalion, and was built under his direction by Chief Gunner's Mate William H. Free.



DETAIL SHOWING ROPES AND OARS.



PROPELLING MECHANISM OF DRILL BOAT.



A LAND BOAT FOR ARMORY DRILL.

The Irish course for the Gordon Bennett motor car race measures 368 miles 765 yards, of which 221 miles are straight road, which will compare favorably with the course of last year in France.

Origin of the Word "Barometer."

The instrument familiar to us all as the barometer, says Henry Carrington Bolton in Science, was first universally known by the name of its inventor as "Torricelli's tube;" de Guericke, the inventor of the air-pump, called his huge water barometer "Semper Vivum," also "Weather Mannikin," with the Latin form "Anemoscopium."

Soon after the year 1665 the words "baroscope" and "barometer" came into general use in England, but the person to whom the credit belongs for originating these terms has not been certainly known; the assertion made by a contributor to the Edinburgh Review for 1812 that "baroscope" was first used by Prof. George Sinclair, of Scotland, in 1668, is an error, for both words occur in the Philosophical Transactions four years earlier. The passage is unsigned and reads thus:

"Modern Philosophers, to avoid Circumlocutions call that Instrument, wherein a Cylinder of Quicksilver, of between 28 and 31 inches in Altitude, is kept suspended after the manner of the Torricellian Experiment, a Barometer or Baroscope, first made publick by that Noble Searcher of Nature, Mr. Boyle, and imployed by him and others to detect all the minut variations in the Pressure and Weight of the Air."

The mention of the words in connection with the name of Robert Boyle has led Mr. Bolton to make a close examination of his voluminous and prolix writings. In Boyle's first publication, "New Experiments Physico-Mechanical touching the Spring and Weight of the Air," dated 1660, the words baroscope and barometer do not occur; he uses the common term "tube," and often writes of the "mercurial cylinder." Nor are these words used by him in his "Defense of the Doctrine touching the Spring and the Weight of the Air . . . against the objections of Franciscus Linus," a paper published in 1662.

Their use by the anonymous writer to the Philosophical Transactions in 1665 has been shown, and the question arises, who was this person who modestly concealed his name? Mr. Bolton believes it was Boyle himself. This eminent man, who was so devoid of personal ambition that he declined a peerage, had a habit of writing about himself and his scientific labors in the third person, and often spoke of himself by fanciful, fictitious names, such as "Philaretus" (in his fragmentary autobiography) and "Carneades" (in the "Sceptical Chymist"). That he should send an unsigned communication to a journal was not surprising, particularly as he had occasion to mention himself.

Be this as it may, my claim that Boyle originated the word barometer does not rest on such slender conjectures as these. One year later than the communication in the Philosophical Transactions, Boyle wrote to this journal (dated April 2, 1666) and said, "barometrical observations" (as for brevity's sake Mr. Bolton calls them), using the personal pronoun this time. Elsewhere in the same paper are found the terms barometer, baroscope, and baroscopical observations.

In his "Continuation of New Experiments Physico-Mechanical," . . . of which the preface is dated 1667, occurs the following phrase: "But though about the barometer (as others have by their imitation allowed me to call the instrument mentioned)." (Boyle's Works, Birch's edition, Vol. III., p. 219, London, 1744.)

This sentence is virtually an admission by Boyle that he had coined the word, since others imitating him had allowed and encouraged him to use the term to designate the tube of Torricelli.

Mr. Bolton concludes, therefore, that the word "barometer" was introduced into our language by the English philosopher, the Hon. Robert Boyle, about the year 1665. Boyle, by the way, was a scholar, and able to use Greek in forming an English word. Examination of Murray's, Skeat's and other standard English dictionaries throws no light on the origin of the word; they merely refer to the Philosophical Transactions and give its obvious etymology.

New York City as a "Spa."

There are, undoubtedly, thousands of residents of upper New York who do not know that there is a water cure or "Spa" conducted within the limits of Central Park. Yet, if the visitor passes through the Seventy-second Street gate on the west side, he will find a number of people walking toward a pavilion not far from the entrance. He will also doubtless be surprised to learn that the majority of these people are acting on the advice of their physicians. Between the hours of five and ten A. M., from five hundred to eight hundred people are served with mineral waters, the greater number visiting the pavilion about half past six. The busiest season is from the first of May until the fifteenth of June. The pavilion was erected in 1867 at the request of numerous physicians who felt that here was an opportunity of combining a mineral water cure with exercise in the open air. The doctors prescribe the kind, strength, temperature and quantity of water, and the amount of exercise to be taken. The attendants follow these instructions with the greatest care. The waters are of two kinds; first the natural mineral waters from all the famous springs at home and abroad, and second mineral waters prepared artificially and scientifically, thus ensuring a definite chemical composition at all times. The double and quadruple Carlsbad seems to be the favorite, and it is mixed with varying proportions of distilled water, and the nat-

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ural mineral waters can be heated in silver cups which are placed in racks in small steam kettles. The little tables are very suggestive of Wiesbaden, Homburg or Carlsbad, and the weighing scale is in constant requisition. By a systematic course of the waters, coupled with proper exercise, it is not unusual to decrease the weight in six weeks by thirty-six pounds, in cases of obesity. The pavilion is patronized by some of the best known people in New York who appreciate the privilege of having mineral waters served under proper conditions.

An Electrically Operated Curtain Hoist.

BY FRANK C. PERKINS.

In every college lecture room, as well as many high schools and institutes, the electric stereopticon is frequently employed in connection with the regular day courses of work. It is then necessary to darken the windows by means of shades, as well as to draw down a prepared white screen for illustrative purposes.

A very ingenious electrical hoisting apparatus, for drawing down the shades and the stereopticon screen at the same time by simply pressing a button or turning a switch, has been devised by Charles W. Carman, of Chicago, formerly the professor of physics at the Lewis Institute.

This automatic electrical device makes it possible for the operator at the lantern to open all the opaque shades of the lecture room or laboratory in an instant by a special switch close at hand. The same device raises the screen out of the way, while another daylight demonstration or lecture is taking up a portion of the time. The curtains are all raised or lowered in less than half a minute from the time the switch is closed, and when fully opened or closed the mechanism is automatically cut out of circuit. The operator after manipulating the switch may therefore immediately give his attention to other work.

The drum is connected to the motor through a worm gear and a magnetic clutch. It is a reversible motor, and by means of a double-throw switch is operated in one direction or the other, depending upon whether the curtains are to be raised or lowered. The limit stop provided breaks the circuit through the motor armature and the magnetic clutch, and changes the connections when the curtains are in their extreme position. The magnetic clutch ceases to act and the curtains are held in position while the armature comes to rest after its momentum is overcome.

The stereopticon screen is connected to the drum by a rope, and the various shades about the room are connected by cords through pulleys to the rope, which extends around the room below the windows. A weight is arranged at the end of the rope, which keeps it taut regardless of the action of the curtain rollers. There are two portions on the drum, one of greater diameter than the other, and the curtain roller cords are connected to one and the stereopticon screen rope to the other, so as to provide for the different ranges of travel. The motor used is of the multipolar direct-current type.

Street Railroads for Conveying Freight.

In the busiest centers of Lancashire, especially so far as the cities of Liverpool, Manchester, and Darwen are concerned, an important development in connection with the electric street railroads is to be undertaken. Hitherto, the surface tramways have been exclusively devoted to the carriage of passengers, but they are now to be employed for the conveyance of freight from one point to another. In Lancashire some 400 miles of these street railroads, all operated by electricity, are rapidly approaching completion, and are to be connected, so that freight can be discharged from, and embarked upon, the cars at any point upon the route.

It is intended that the merchandise shall be carried only during the night. Throughout the day the passenger service in these centers is so busy, that to handle freight at the same time would only interrupt and disorganize the passenger traffic, whereas at night, although there is still a demand for passenger transit, necessarily it is limited, so that freight cars will be able to run quickly and without causing any inconvenience.

The first step toward the inauguration of such a service has been taken by the corporation of the city of Liverpool with its street tramways, by an agreement to connect its system with the docks' surface railroads, thus securing direct access to the quays, warehouse, and vessels, picking up the freight and distributing it without further handling in the various parts of Lancashire where an electric tramway is in operation.

Such a system will considerably facilitate and cheapen the cost of transit of freight from the vessel's side at Liverpool docks to the Lancashire towns, especially Manchester. By the present system of handling the merchandise upon the trunk railroads, in the majority of instances, there are no less than six transshipments of the goods, from the moment they are discharged from the ship to their delivery at their destination. By the surface tramways all this extra labor will be obviated. The trolleys laden with goods will run straight from the docks into the factories, or *vice versa*. The saving in time and labor alone by this system will be enormous, while it will also be fifty per cent cheaper to convey goods by this means than by the ordinary railroads.

GUILLEMINOT HIGH-TENSION AND HIGH-FREQUENCY COILS.

BY EMILE GUARINI.

Dr. Guilleminot recently published the results which he had succeeded in obtaining with an arrangement for the purpose of analyzing the effects of high frequency obtained with ordinary resonators. He prepared a coil or spiral of copper wire of constant pitch. Through the outermost convolution (Fig. 1) the oscillatory current of two Leyden jars was passed. At the center of the spiral, currents of exceedingly feeble intensity were received.

By modifying the pitch of the spiral and rendering

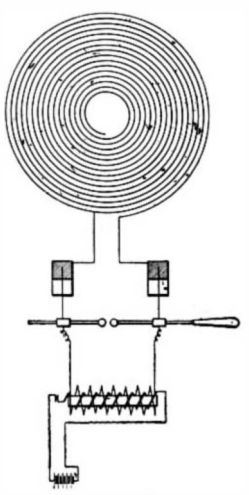

Fig. 1.

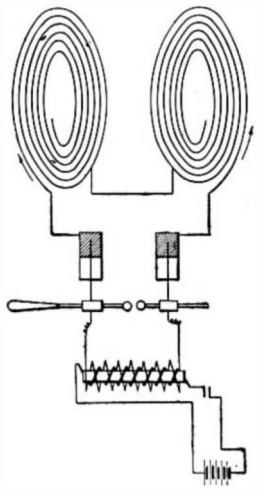

Fig. 2.

it progressively increasing from the center to the periphery, the effects obtained were more marked. The increase of pitch was based on the difference of the length of the spark which passes between the two adjacent points. This increase was 0.003 mm. between convolutions, an induction coil having a spark of 0.35 mm. being employed at 6 amperes to charge the Leyden jars.

Dr. Guilleminot studied the effects obtained with two spirals. The results were remarkable. An enormous field of action was given to the neighboring resonator. Experiments conducted in conjunction with MM. Radiguet and Massiot proved that if a passive spiral be submitted to the influence of an active spiral, entirely different effects, dependent upon the direction in which the convolutions run, are obtained; if two spirals be connected in multiple (Fig. 2) or in tension, the effects are again entirely different, dependent on the direction of the oscillating discharge in the first spiral. From these experiments it follows that in two spirals the same charging effect can be obtained, either by influence due to winding in the same direction, or by proper connection due to symmetrical mounting; and that it is possible to

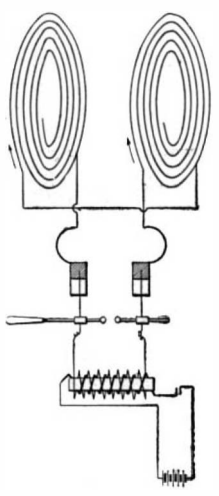

Fig. 3.

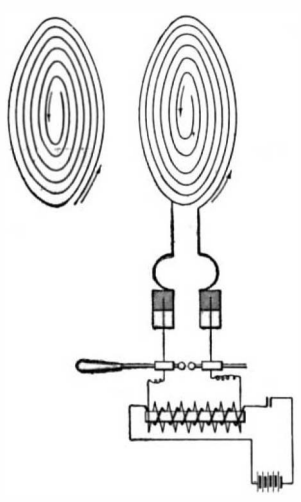

Fig. 4.

obtain a counter-discharge effect either by influence or by proper connection.

Dr. Guilleminot has also ascertained the effect of combined inverse connection and inverse winding. The results obtained are striking. Superb interpolar effects were secured. A body interposed between the two spirals glowed at two sides.

By homologous connection and winding feeble current effects were obtained; a body interposed between these spirals emitted flaming streams.

It will be observed that Dr. Guilleminot's spirals enabled him to obtain two entirely different effects, one monopolar and the other bipolar. The therapeutical value of these coils should not be underestimated. Electric shower baths can be taken, which will doubtless have no slight beneficial effect upon the nerves.

American Gunnery: New Record.

The report that American gunnery is not what it was during the Spanish-American war is tellingly refuted by the accounts which have been received of target practice in the Gulf of Mexico. During the Spanish-American war it was estimated that only three per cent of the shots fired by American gunners hit the enemy's ships. Still, that was considered very good shooting. Tables have been prepared of the recent work done by seven battleships of the North Atlantic fleet. These tables are complete for all ships except the "Kearsarge." The score made by the other six vessels foots up a fine average of 51.5 per cent. The record of prize firing by the British fleet on the Asiatic station shows that the average percentage of hits was 49. Of these English vessels the best performance was that of the "Oceanic" whose record was 68 per cent of hits with a 12-inch gun. The "Alabama" with her 13-inch guns, striking the target 22 times out of 32 times, shows that her record is 67.12 per cent. The "Illinois," a sister ship of the "Alabama," made a record of 53.1. The performance of the older ships was not so creditable. With her 13-inch rifles the "Massachusetts" hit the target only 6 times out of 15; the "Indiana," however, a sister ship of the "Massachusetts," missed the target only 6 times out of 24 shots. What target practice means is strikingly shown by the case of the "Texas." This vessel was only recently placed in commission, so that her men had no experience with target work. Her record was only 39.3 per cent. The records which have been made are remarkable when it is considered that at 1,600 yards a target, viewed through the peephole of a turret, looks no larger than a visiting card held 100 feet from the eye.

Using Aluminium Condensers to Produce "Singing" Arcs.

In an article communicated to the Russian Physico-Chemical Society, W. Mitkiewicz suggests replacing the ordinary high-capacity condensers necessary to produce Duddell's "singing arc" by the much less costly aluminium condenser made up of an aluminium electrode connected with the positive pole immersed in a 7 to 8 per cent sodium bicarbonate solution, and thereby becoming coated with a thin layer of oxide or hydroxide. Two plates of sheet iron of the same dimensions are placed upon the faces of the condenser, from which they are separated by means of thin caoutchouc, so that the distance between the aluminium and each of the iron plates does not exceed 3 millimeters. The whole system is provided with caoutchouc rings, and placed in the vessel containing the solution. The iron plates are, of course, connected with one another by means of a metal wire. The capacity of such a condenser with a working surface of about 5 square dm. was of the order of 100 microfarads. The magnitude of this capacity is due to the extreme thinness of the insulating layer. In order to produce with this device the phenomenon known as a "singing arc," Duddell's arrangement is made use of. After each experiment the electrodes must be taken out of the solution and carefully dried. This condenser may be advantageously used for many other experiments as well, e. g., for all "speaking" arc devices. Full particulars are given of the apparatus employed.

The Current Supplement.

The current SUPPLEMENT, No. 1429, opens with an article on some modern types of Swiss and German bridges, editorially referred to in another part of this issue. The article discusses these bridges both from an engineering and architectural standpoint. The text is illustrated by pictures of several types. The investigation of a garbage crematory is concluded. Some new lightships on the coast of France are described and illustrated. Sir Oliver Lodge's paper on Electrons is continued. An article by Prof. Goodyear on the "Architectural Refinements of St. Mark's, Venice," will be found to contain many a striking bit of information on the architectural beauties of Italy's most famous cathedral. Perhaps the most important subject which is discussed in the current SUPPLEMENT is that of radium and other radio-active substances. The article comes from the pen of William J. Hammer, and is probably the most exhaustive account which has so far been published. Numerous illustrations are given of the marvelous activity of these newly-discovered substances. Serpollet's steam automobile is described in the second installment of the article begun in the last issue.

Ruchomowski, who has achieved no little notoriety by reason of his skill in the fabrication of the tiara of Saitaphernes, seems also to have been the author of other curios which their owners have fondly imagined to be genuine antiques. M. Reitlinger, who thought he owned four valuable antiques, now receives the unpleasant news from Ruchomowski himself that they came from the hand of the Russian craftsman.

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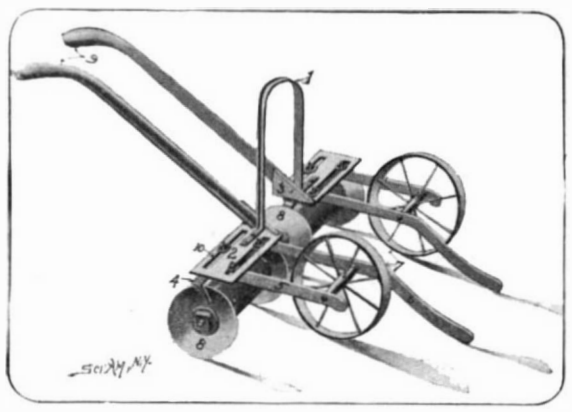
Patent Department

ADJUSTABLE CULTIVATOR.

A patent has recently been granted to Mr. Arthur A. Thogersen, of Brookings, South Dakota, for an improved cultivator of a type used in gardens and nurseries for the cultivation and weeding of small plants. The improvement lies in the provision of means for adjusting the cultivator disks relative to the main frame, or to the rows of plants, so that the soil may be thrown toward or away from them, as occasion may require. The ground wheels and beams

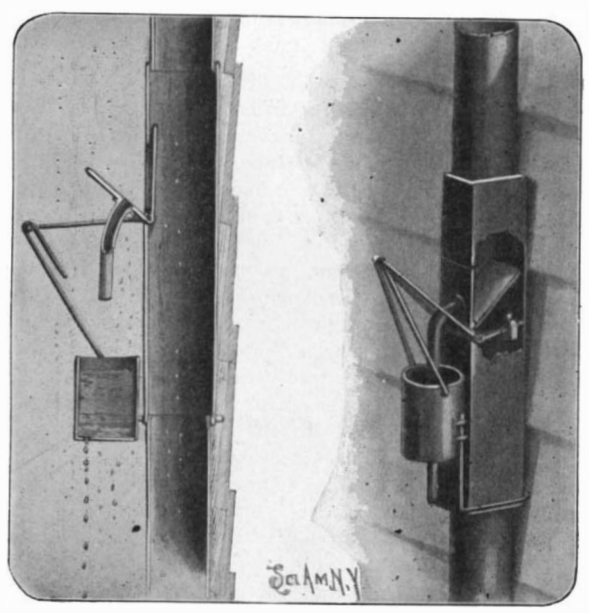


ADJUSTABLE CULTIVATOR.

may also be shifted laterally to a sufficient degree to permit passage of large plants or bushes. The construction of the cultivator will be readily understood by a glance at the accompanying illustration. The frame comprises the usual arch 1, which connects the angle plates 2, and the handles 9, secured to the vertical portions 3 of the plates. The plates are provided with lateral slots 10, through which the pivot bolts of the bearing sleeves for the cultivator disks 8 project. The bars or beams 5 and 6, supporting the ground wheels 7, are similarly secured to the frame by bolts projecting through slots in the plates. Now, according as the rows of plants to be cultivated are close together or far apart, by loosening the nuts on the pivot bolts, the pairs of disks may be shifted to a corresponding distance from each other. By swinging the bearing sleeves about on their pivots, the amount of soil broken up by the disks, and the direction in which it is thrown, may be governed at will. The scrapers 4, which swing with the bearing sleeves, serve to remove any soil that may collect on the disks. It will be observed that the beams 6 are extended and curved downward to the ground. These serve to stir up the soil adjacent to the rows of plants, thus rendering them more susceptible to the disintegrating action of the disks.

USEFUL ATTACHMENT FOR RAIN-WATER LEADERS.

In many localities rain-water when pure is preferably used for drinking purposes, being collected from the roofs of houses and kept in cisterns. One serious objection to rain-water thus collected lies in the fact that during dry weather impurities of many sorts gather upon the roof, and these when washed into the cisterns, often contaminate the water thus collected, and render it unfit for use in cooking or on the table. Mr. John Keller, of Ottoville, Putnam County, Ohio, overcomes this objection in the following manner. Located at any desired point on the rain-pipe is a box-like section containing in its front wall an opening closed by a two-part gate valve. This valve consists of two gates joined at the bottom, preferably at an angle of 45 degrees. The valve is rigidly secured to a shaft which has bearings in the sides of the box section. To the projecting ends of this shaft, the ends of a U-shaped rocker arm are secured, and from this rocker arm a water pail is hung, being adapted to slide between guide bars on the box section. Normally the parts assume the position shown at the right in our engraving, being thus held by a weight on an extension of the rocker arm. In this position it will be observed that the inner gate closes the passage through the box section, while the outer gate closes the opening in the front wall. The only outlet for the rain-water therefore is through a spout in the outer gate and thence into the water pail. The water will continue to flow into the pail until the increased weight of the latter overbalances that of the weight on the rocker arm, when the pail will drop, and the gates swing out to the position shown in our sectional view. By this time the impurities on the roof will have been washed off, and the pure water will flow down through the rain-pipe into the cistern. By adjusting the weight on the rocker arm, the amount of water allowed for washing off the roof may be varied at will. The water pail is provided with an opening at the bottom, through which this impure water may escape; the opening may be normally closed, or if it be exceedingly small, so that it would require several hours for the pail to empty, the opening may remain open continuously.

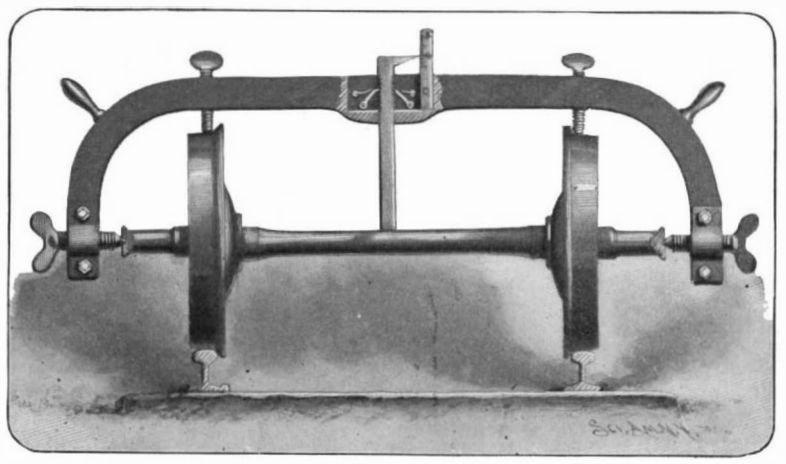


USEFUL ATTACHMENT FOR RAIN-WATER LEADERS.

HEATER ATTACHMENT FOR LAMPS AND GAS BURNERS.

The problem involved in the effort to utilize the waste heat of a lamp or a gas jet, for the purpose of warming a room is no small one. The natural tendency of heated air, on account of its expansion, is to travel upward; consequently, the lower parts of a room may be very cool while the ceiling is lined with a layer of hot air. Some systems make use of mechanical means for casting the heat down where it is needed, but obviously, such mechanisms could not be economically applied to a small heater adapted to be used on a kerosene lamp, a gas jet or the like. However, a very simple solution of the difficulty has been found. Heretofore inventors have apparently been experimenting with heat only as carried by a draft of air. Heat may be easily absorbed by an air current and again radiated out at some other place, but this is evidently an indirect method of distribution; for like light, heat is a vibration of the ether and may therefore be transmitted without the aid of any other medium. The heating of any material substance is merely the gradual communication of this vibration to the particles of the substance. With this brief review of high-school physics, we can readily see that the rays of heat may be made to travel in any desired direction, regardless of air currents; that the heat rays of a lamp may be reflected down to the floor in exactly the same way as light rays can.

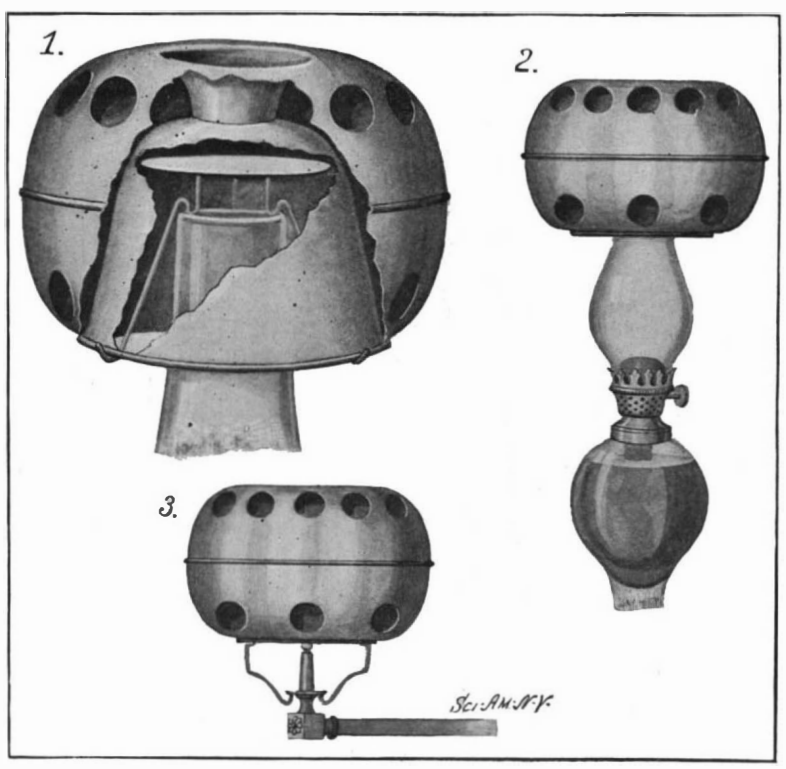
A simple device used to accomplish this result is pictured in the accompanying illustration. It consists of a parabolic reflector surrounded by a drum and supported on a bracket. Two forms of bracket are provided—one adapted to be attached to a gas burner, Fig. 3; and the other applicable to a lamp chimney, as shown best in Fig. 1. The heat rays on striking the walls of the parabolic reflector are cast downward in parallel beams. In the case of the lamp bracket, a buffer plate lies under the draft opening in the top of the reflector. This is necessary because most of the heat passes up the chimney and must be spread out to come in contact with the reflecting wall. The drum serves to assist in the circulation and to prevent the reflector from injury under the intense heat. Part of the heat is of course taken up by the air and the products of combustion, and passes up through the draft opening; but a large percentage is reflected down despite the strong upward air current. This may be demonstrated by the use of a lighted cigar, the smoke of which will be seen to pour into the reflector and out through the draft opening, while in the meantime, heat can be strongly felt at a considerable distance below the reflector. This heat is of course free from those objectionable gases resulting from combustion, and is consequently more healthful than the air which passes up to the ceiling. It also sets up a general circulation in the air with which it comes into contact, and these currents do not pass through the flame to be robbed of oxygen. It is claimed that this device will heat a room ten by twelve feet to 76 deg. when the thermometer outside is at zero, and that in such weather the capacity of each heater on an ordinary gas jet is about 12 deg. an hour; this necessarily increases or decreases according to the temperature outside. The device offers the further advantage of utilizing the heat without any reduction in the light-giving power, for even on a gas jet the heater is supported with the bottom on a level with the tip of the burner, and the parabolic reflector, particularly if kept bright, throws down a concentrated light on the work below, which means that at night, when a light is necessary, the heating of a small room is done at no cost whatever. The heater is made by the Giant Heater Company, of 68 Monmouth Street, Springfield, Mass.



GAGE FOR RAILWAY CAR AXLES.

GAGE FOR RAILWAY CAR AXLES.

In railway shops where the rolling stock is brought in for repairs after accidents or long usage, it is very convenient to have a gage which will, at a single measurement, detect any misplacement of car-wheels on the axles, and any flattening of their treads, and also any bend in the axle itself. Such a gage, in improved form, has been invented by Messrs. F. J. Compliment and J. O. Robinson, of Ironton, Ohio. The construction of the gage is shown in the accompanying illustration. It comprises a frame or yoke adapted to span the car wheels and axle and having, in its downwardly-turned ends, screws adapted to engage the lathe-centers of the car-axle. Movable vertically through the center of the yoke is a gage-bar designed to indicate the trueness of the axle. At the upper end of this gage-bar is a pointer movable along a graduated plate. Ratchet-teeth are formed on the bar below this pointer and are engaged by spring-pressed pawls. The yoke is further provided with gage-screws designed to engage upon the periphery of the wheels, to indicate whether or not they have slipped on the axle. In operation, the axle-gage is applied to the car wheels and axles in the manner illustrated, and then the wheels are moved over a floor or a track, and the frame is held in vertical position by means of the



HEATER ATTACHMENT FOR LAMPS AND GAS BURNERS.

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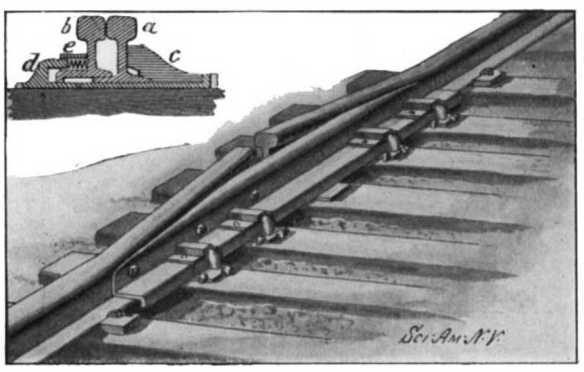
handles thereon. The central gage-rod resting on the surface of the axle will point to zero on the scale plate provided the axle is true. If, however, the axle be bent or sprung, the bar will be raised as the wheels rotate and the amount of deflection indicated on the scale plate. At the same time the gage-screws resting on the peripheries of the wheels should be watched to detect any flattening in the treads. Any misplacement of the car wheels on their axle will be immediately observed by noting their relation to these gage-screws.

RAIL CONNECTION.

The large number of patents on rail joints which are being issued each year indicates the importance of this part of a railway track, and also shows that the problem has not yet been satisfactorily solved. Mr. Alexis Hauptmann, of Beaumont, Tex., has attacked the problem from a new standpoint. Instead of providing devices for joining each rail to the next adjacent one, he proposes to weld together a large number of rails by electricity or any other suitable

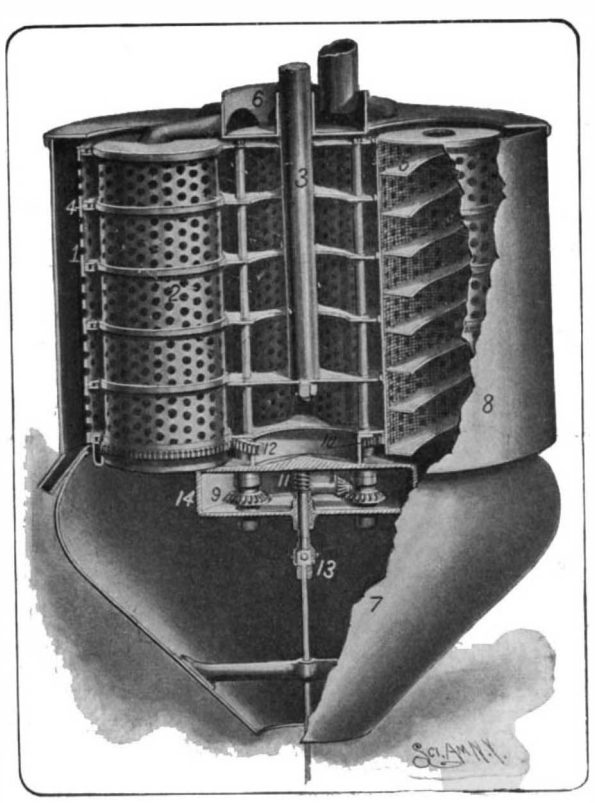


RAIL CONNECTION.

means, and then to join these long sections with a connection which allows for expansion and contraction. Moreover, the connection provided is of such a nature as to cause no break in the track, thus doing away with the objectionable pounding of car wheels in passing over the usual rail joints. The connection used is shown in our illustration. It will be observed that the track sections to be joined are bent outward at their ends and are connected by a rail which is tapered to fit these ends. This connecting rail is securely bolted to one of the track sections but has sliding connection with the other. This is necessary to allow for the extra large expansion and contraction of the track section due to the length of each section. A chair permitting this sliding connection is illustrated in our small detail view. Here the rail section *a* and the connecting rail *b* are supported on a bed plate. Formed on one end of this plate is a chair *c* engaging the rail section, and at the other end a stud *d* projecting into a casing *e* and pressing the spring held therein against the rail *b*. This holds the parts with all the necessary rigidity, but at the same time permits slight longitudinal movement of the track section. To further prevent interference with this sliding movement the bedplates for the track sections are recessed to admit the base flanges of the rails, and the spike holes are so placed that the shank of the spike does not touch the rail, but only the head engages the top of the flange.

CENTRIFUGAL SEPARATOR.

The new type of separator for sugars and other sub-



CENTRIFUGAL SEPARATOR.

stances which is illustrated herewith, offers the advantage of permitting the material to be continuously fed and distributed while the parts are rotating at high speed, thus obviating the necessity of stopping the machine to place the material therein, and saving the time and power incidental thereto. The machine provides for the thorough separation and isolation of the liquid from solid matters, and for forcing the latter positively down through the separator. It comprises a drum rotated at high speed, within which a number of treatment cylinders are mounted which have a slow rotary movement on their axes. In our illustration the drum may be seen in section at 1, revealing the treatment cylinders 2, mounted therein. The interior of the drum is provided with a number of plates or webs, two of which are secured to the shaft 3. The treatment cylinders are held loosely in openings in these webs, being supported by flanges at the top. Raceways 4 are formed along the edges of the web openings to receive rollers or balls, which bear against track-bands on the cylinders and serve to diminish the friction when the cylinders are in motion. The sheet-metal walls of the cylinders have a large number of perforations, through which the liquid is thrown by the centrifugal energy developed in the rapidly-rotating material, the solid matter being retained by the wire-screen lining of the cylinder. Each cylinder is provided with a feeder consisting of a broad strip of metal bent in the form of a helix, as shown at 5. In operation the drum is driven at a high rate of speed by any suitable motor acting on the shaft 3, and the material is fed into the cylinders by centrifugal action from a hopper 6. Owing to the high speed of rotation of the drum, the material in each cylinder will hug that part of the circumference which is furthest removed from the center, the liquid part passing out through the perforations. By a system of gearing the cylinders are made to rotate slowly on their axes, so that the spiral feeders force the solid material downward until it passes into the stationary receptacle 7. The liquid, in the meantime, is entirely drained out, and passing through perforations in the drum, is caught in a trough at the bottom of the stationary casing 8, whence it flows out through the discharge pipe. The gearing which provides for the independent rotation of the cylinders comprises the bevel gears 9 and spur gears 10, mounted to revolve with the drum 1. These gears are caused to rotate on their own axes by means of worm gears meshing with the stationary screw or worm 11. The gears 10 engage an independent gear ring 12, which meshes with the gear on the bottom of each cylinder. It is evident that by this system of differential gearing the cylinders are made to slowly rotate while revolving about the common axis of the drum. The universal joint 13 on a stationary shaft provides for any irregularity of rotation or oscillation of the gear casing 14, which is rigidly secured to the drum and yet has bearing on the stationary shaft of the worm. The inventors of this machine are Messrs. W. G. Hall and W. A. Ramsay, of Honolulu, Hawaii.

Brief Notes Concerning Inventions.

In the stockyards at Chicago, an electric goad has taken the place of a whip in urging the animals along through the various passages to their place of execution. This implement has been found to have many advantages, mainly in the fact that it is even more effective than the whip, and does not in any way affect the meat. The idea has been further improved upon in the invention of James A. Giles, of Elberton, Ga., a rural letter carrier, who has conceived the notion of using electricity to urge along his horse when attached to the carriage. The wagon made use of by Mr. Giles in the pursuit of his daily vocation must be entirely inclosed in order to protect the mail matter from the weather, and under the circumstances the use of a whip of the ordinary type is a very inconvenient matter. So the suggestion occurred to him to make use of an electric current as a substitute for the lash. His first experiments in this line were successful in the extreme, and he at once built a substantial device to be permanently made a part of his traveling outfit. Now, when he wants to stir his steed up a little, he merely gives a few turns to the handle of a small generator, and the effect on the animal is like magic. Mr. Giles is of the opinion that these occasional shocks of electricity are decidedly beneficial to the animal instead of doing injury to it. The shock is administered to the horse through the means of two plates inconspicuously placed under parts of the harness.

George C. Hale, the former chief of the Kansas City Fire Department and the inventor of the swinging harness, the water tower, and an automatic alarm, has just completed another invention which will add greatly to the glory he has achieved in this line, if it proves to be entirely satisfactory. His invention is an improvement on the automatic sprinkler, and does away with one bad feature of that device, and that is the great damage by water, which frequently takes place by the unnecessary flooding of a comparatively large area for the purpose of quenching a fire which may be confined to a few feet of floor space. It has frequently happened that where the fire has broken out and been extinguished without discovery, the sprinklers remain in action for hours afterward, and the water has done as much damage as a serious fire. In the apparatus designed by ex-Chief Hale, he combines some of the features of the sprinkler system with that of the Babcock tank extinguisher. The pipes, instead of being filled with water, contain air under pressure. The unusual heat causes the breaking of a seal, as in the case of the sprinklers, and this release of air automatically performs the operations of generating the gas, which thereupon issues from the pipes and extinguishes the fire by smothering it. There is a small amount of water in the tank, which is necessary to create the pressure of gas which is necessary, and some of this issues through the pipes, but it cannot under any circumstances be enough to cause any great damage. This system has been perfected and subjected to public trials, which are said to have proven entirely satisfactory. Application for a patent is pending.

The report of the Commissioner of Patents for the past fiscal year shows that the number of applications was greater than ever before, having exceeded the 50,000 mark. The total number of patents granted was 27,387, including reissues and designs, 1,864 trade-marks, 750 labels, and 163 prints. The number of expiring patents, 20,335, and the number of allowed applications which were forfeited by reason of the non-payment of the final fees was 4,123. The total receipts of the office were $1,491,538.85, and the total expenditures were $1,329,924.63, the surplus of the receipts over the expenditures being $161,614.63. In his report the Commissioner notes a very gratifying decrease in the number of complaints of losses of money in the office. From September 1, 1900, to June 30, 1901, the amount of losses aggregated $686.13, while for the corresponding ten months of the past year the amount had been decreased to $9.35, and the Commissioner states that all of this can be charged to losses in the mail, and to claims erroneously made. The Commissioner urged the appropriation of a larger sum for the purchase of reference books for the library. The amount heretofore available for the purpose has been $2,000, and a large part of that has been necessarily spent in sending the publications of the office to the offices of foreign countries. The Commissioner is of the opinion that the amount appropriated for this purpose should be doubled.

Propeller blades of cast iron are in general use, on account of the great cost of those of bronze. The life of a cast-iron blade is very uncertain, owing to the two facts that they are very easily broken and also that they are particularly subject to corrosion. Corrosive action invariably attacks what is known as the "tip" of the blade, which is not the point particularly, but covers an area from twelve to eighteen inches from the point. It is a comparatively simple and inexpensive matter to replace the blade which has become broken or worn by corrosion, but the operation is one which requires several days' work, and it is this delay which is a serious matter to the ship's master. A process has been recently devised and patented by Charles Fleming, of Sydney, New South Wales, by which the damaged portion of the blade can be replaced in a few hours with either cast iron or bronze and at a trifling expense. The corroded or damaged portion is broken away, and the remaining part is bedded in the foundry floor, and a cope rammed up over the part which is to be renewed. The mold is then parted, finished, dried, closed, and cast with the desired metal, and it is here that the novelty of the process enters into the operation. The joint is then burned, care being taken that the metal from the ladle falls on the cast portion of the blade if the new part be of bronze. This mend is said to be thoroughly serviceable.

A machine for making railroad ties, which is regarded as a remarkable innovation, has been on exhibition recently in New Orleans, La. It is the invention of Constantine Hege, a lumberman hailing from Salem, North Carolina. A company has been formed to exploit the patent. The president of this corporation is Thomas Gibbon, vice-president of the San Pedro, Salt Lake & Los Angeles Railroad. By human labor, not more than ten or a dozen ties can be made per day per man, but by the aid of this machine it is claimed that four hundred ties can be made in the same time. These, too, are much more regularly formed than those made by the laboring man with his broadax. The machine is constructed somewhat on the principle of the lathe, augmented with a long steel roller set with about thirty blades, regulated with a system of projecting necks, so that they can cut only to the depth of a sixteenth of an inch at each stroke. The log passes back and forth a few times, and is trimmed down to the desired size and shape.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

MACHINE FOR HULLING OATS.—S. E. FIELD, Victoria, Canada. In operation this machine receives the oats in a hopper and guides them to rollers in such manner that the rollers will nip the heads of the oats and will squeeze out the groats, the groats falling within the machine, while the hulls pass through to the outside. The oats and other grain may be hulled without going through any previous preparation or process.

PLANTER.—J. P. CALDWELL, Winnsboro, S. C. The present invention relates to an improvement upon a former patent granted to Mr. Caldwell in 1900. The seed-planting wheel may be used at will for planting cotton-seed or smaller seed as peas and corn, the dropping mechanism being automatically operated. The seed-dropping mechanism may be rendered inactive, so that larger or smaller seed may be planted or the seed planted at intervals, thus avoiding chopping out the rows, after the plants have grown. The machine opens a furrow, covers the seed and rolls the covering down; it distributes fertilizing material and provides agitating devices for the bulk of the seed and the fertilizing material.

THRESHING-MACHINE.—N. E. HEIEREN, Baxter, Minn. The old form of grain-pan is improved upon in this invention, by providing such pan with means, whereby should any grain be fed forward with the chaff from the first series of chaffers such chaff containing grain will be compelled to pass over the second series of chaffers before the chaff is thrown off on the chaff heap. The auxiliary chaffers of the grain-pan are adjustable and operate with any kind of grain so as to separate it from the chaff. The fan is located below the grain-pan so that the blast of air therefrom is diverted into the pan and upward through the spaces between the chaffer-slats.

GRASS-SEED STRIPPER.—H. T. and W. H. MCCORMICK, Winchester, Ky. This stripper is in the nature of an improvement in devices employed for stripping off grass-seed or the heads of grain. The invention gives ample room for the workman in the box and allows the use of moderate sized wheels; the shafts are attached close to the centers of the wheels, making a light draft; and, as the seedbox is rigid with the axle and is arranged to oscillate with the axle in the hub of the wheels instead of on the axle, the machine may be used on a hillside as well as on level ground.

Electrical Improvements.

ELECTRIC STOP-MOTION FOR KNITTING-MACHINERY.—A. L. PATTERSON, Albemarle, N. C. This device is of that class known as "electric stop-motions" for knitting-machines. It is controlled by electromagnetic mechanism and circuits which automatically stop the operation of the knitting-machine whenever the yarn breaks or too much slack occurs from a failure of the tension devices to work properly.

COMBINED ELECTROLYTIC AND MECHANICAL INTERRUPTER.—H. R. SMITH, Altoona, Penn. This improvement has reference to an interrupter suitable for the operation of Ruhmkorff coils and the like, and comprises both an electrolytic or Wehnelt interrupter of modified form and a mechanical interrupter connected therewith, the two interrupters mutually qualifying the effect of each other.

PLATE FOR ELECTRIC ACCUMULATORS.—D. TOMMASI, 7 Rue des Immeubles Industriels, Paris, France. This system of accumulator-plate is characterized; first, by the employment of strips placed in close proximity to each other in the empty spaces of the lead grid or frame of the plate, the strips serving to retain the active material and permit of the uniform distribution of the current throughout the mass; second, by the employment of a diagonal conducting-strip upon one face of the plate, the strip extending from the angle corresponding to the point of entry of the current and serving to insure a uniform distribution of the current through all parts of the plate.

Engineering Improvements.

STEAM-BOILER.—M. K. VAN DER VELDE, Chicago, Ill. In the operation of this boiler, the steam is generated on the several surfaces or levels of water, and the steam generated in the bottom pan forces the water downward moving the float down and opening a valve, so that the steam may pass into the middle pan, and the steam with the steam generated in the middle pan will cause the valve to open, permitting the steam to pass into the upper space of the boiler or into the space in the top pan and thence out through the steam-pipe.

INJECTOR.—S. F. SIPLE. Address mail matter to Eli H. Goslin, Petersburg, Indiana. The adaptation of this injector is essentially for injecting air or other analogous gas into steam for the purpose of increasing the volume of the steam. The invention also resides in a novel combination of an injector with a source of steam and a motor driven therefrom.

Machines and Mechanical Devices.

HOISTING DEVICE.—M. RATH, Two Rivers, Wis. Embodied in this invention are improvements in hoisting devices or elevators, particularly adapting the apparatus to the use of builders in raising brick and other building material to the place of work, the object being to provide a hoisting device that may be readily placed in position and adjusted to height as the building progresses.

WASHING-MACHINE.—D. S. TYLER and L. D. TYLER, Indianapolis, Ind. The inventors' principal object is to provide means whereby to thoroughly and easily cleanse and turn the clothing during the washing operation, as well as means for securing the wringer so that the wringer can be quickly turned into and out of position for use.

SELF-OILING JOURNAL BEARING.—G. A. ENSIGN, Defiance, Ohio. In the present case the improvements refer to journal-boxes of the ring-oiler type; and their object is to provide a new self-oiling journal-bearing which is positive in action, requiring little attention, and arranged to uniformly distribute the lubricant to all parts of the bearing and to permit employment on high-speed shafts.

MACHINE FOR PRODUCING APERTURED DISKS.—G. A. ENSIGN, Defiance, Ohio. This invention relates to woodworking machinery; and its object is to furnish a new and improved machine for producing apertured disks in a simple and quick manner, the disks produced being accurate in shape and the device readily worked without the use of skilled labor. For producing larger or smaller sizes of disks correspondingly-sized cutter-heads and augers are employed.

GRAPHOPHONE - REPRODUCER. — W. HART, Kirksville, Mo. This inventor's improvements relate to graphophones, and his object is to improve the sounds made by the reproducer, and also to provide certain adjustments for regulating the sounds reproduced. Double diaphragms are used, and the sounds produced by this device are louder, clearer and richer than those afforded by the ordinary reproducer.

GUN BORING AND BURNISHING MACHINE.—T. C. HISTED, Pittsburg, Kan. The improvements in the present invention relate to machines for choke-boring a gun-barrel and burnishing the interior of the barrel, the object being to furnish a machine of simple construction to be made and sold at a low cost and that may be readily operated by any person either skilled or a novice in the art of gun making or repairing.

FLYING-MACHINE.—O. A. KAEHLER, Detroit, Mich. In operating this machine, the operator from his seat causes the rotation of the cranks by foot power or any other well-known motor, and thereby revolves the wings. A lifting effect is thus produced by the reaction of the air upon the wings. The operator steers by means of hand-cranks, one of the propellers at his right and the other at his left, so that he can turn either at will in either direction. These propellers drive the device forward or backward. In alighting the speed of the wings is slowed up, the machine gently descending, the buffers cushioning the force of the alighting frame.

FRICTION-COUPLING.—A. LEIKEM, Chicago, Ill. Provided in this invention is a new and improved friction-coupling, more especially designed to couple shafts together, and arranged to positively lock the driving-shaft to the driven shaft in case the contact friction-faces of the coupling members slip one on the other under a heavy load, and to insure proper friction contact of the faces in case the shafts move out of longitudinal alinement.

STOP-MOTION MECHANISM.—L. D. WADE, Cedartown, Ga. Mr. Wade's improvement in this invention relates to stop-motion mechanisms for weaving-machines, looms and other devices used in operating textiles. It is based upon the principle that the breaking or slackening of a thread controls an electro-magnet, and thereby disconnects some part of the machinery.

DRIER.—J. WATERHOUSE, New York, N. Y. This invention relates to improvements in machines for drying fruits, meats, sand, and matter containing precious metals or gems, and the object is to provide a machine of this character with which moisture and light dust may be quickly and effectually separated from the material.

Metallurgical Apparatus.

APPARATUS FOR TREATING ORES.—H. HIRSCHING, San Francisco, Cal. The primary object in view in this invention is to provide an improved apparatus for treating ores containing copper, zinc, nickel, silver, and gold, which apparatus can be successfully employed whether one part or all of the above mentioned metals are contained in the ore.

GOLD-DREDGER.—O. F. BARNES, Arcola, Ill. The usual suction-dredgers are impractical or of little use in elevating gold from a river-bed or the like, because of the great specific gravity of gold as compared with sand and gravel—that is while sand and water are lifted by the suction the gold will sink into the sand-bed too deep to be lifted by the suction. The object, therefore, is to provide means for collecting gold with the sand at a point so near the inlet of the suction-pipe that the gold will be elevated by the suction-draft.

Vehicles and Their Accessories.

VEHICLE-BRAKE.—E. KEPP, Xenia, Ill. The object in view in this device is to provide a brake mechanism so arranged that it may be set to apply the brake to a team holding back on the vehicle-tongue, to apply the brake by either pulling or back pressure on the tongue, to apply the brake by pulling strain alone, and to so place the parts that the brake cannot be set by either forward or back strain on the tongue.

Miscellaneous.

MEASURING INSTRUMENT.—I. B. HAGAN, North Lamoine, Me. In this measuring instrument, the object is to provide a simple and inexpensive device that will be found useful to surveyors, engineers or others in laying out or plotting angles, measuring distances, and plotting work generally. The wide range of its measuring is shown in the capacity of the instrument to find the course or bearing and distance of two objects at sea, or to lay out rafters for building purposes.

SLICING-KNIFE.—W. KELLEY, Scammon, Kan. This invention relates to that class of knives provided with a plurality of blades held in parallel planes on a single handle. The object is to provide a knife adapted to cut a plurality of slices at one time and also by easy detachment of the two outer blades from the handle enable the use of a central blade for cutting bread or cake with one edge of this blade and meat or more compact substances with the opposite edge.

MOVABLE LETTERS FOR ADVERTISING-BOARDS.—T. KNOBLICH, 43 Pferdemarkt, Hamburg, Germany. This invention has reference to movable letters for advertising purposes, which either singly or connected, so as to form words and either in or not in connection with other immovable letters, shall be used for advertising words, for the purpose of drawing the attention of the public through either movement, to such advertisements with which they are connected.

UNDERWAIST.—E. H. HORWOOD, Hoboken, N. J. In this case the inventor provides a construction of undergarments in which gathers, plaits, or shirrings are used, and in which a yoke is so combined with the body as to take all the strain from the gathered-in fullness, thus preventing the gathers, etc., from being drawn or wrenched from position at their edges. The yoke has integral shoulder-straps and the body has stays at the top and bottom of the gathered material, the upper stay reinforcing both the yoke and the body.

WARDROBE-TRUNK.—N. BARUCH, New York, N. Y. The construction invented by Mr. Baruch relates to a wardrobe-trunk admitting of general use, but particularly desirable for actors, traveling salesmen, and others who have frequent need of carrying wearing-apparel from place to place in journeying to any great extent, and who know the value of being able to dress in becoming style where little time is available for the purpose.

TEMPORARY BINDER.—F. B. TOWNE, Holyoke, Mass. Means are provided in this invention for increasing the capacity of a binder in storing or filing leaves or sheets. Extensible posts with adjustible ratchet members are provided, the members being attachable and detachable to allow increase or decrease in the length of the posts. The adjustable ratchet members of the posts co-operate with locking devices on a shiftable locking-slat which may be equipped with a waste leaf, and these ratchet members are formed with teeth always in position to engage with the locking devices on the slat.

BRUSH.—D. F. MAHER, Watsonville, Cal. While the application of this invention is mainly to a tooth-brush, it may be embodied in other brushes. The object is to provide a brush which can be readily and thoroughly cleansed by forming one of the sections movable relative to the other sections, so it can be slipped out of imediate relation with the fixed sections to facilitate the complete cleansing of the brush.

EGG-PRESERVING COMPOUND.—J. M. BROOKS, Clifton, Texas. Mr. Brooks is the inventor of a new composition of matter which is used for the preservation of eggs. It keeps eggs sweet and fresh for months at a very low cost. The operation of treating the eggs is very simple and can be quickly and easily done when transferring the eggs from bulk to the shipping cases.

SHIP'S TABLE.—W. J. PREATER, Elizabeth, N. J. In carrying out this improvement, the inventor's particular point in view is to construct a table not liable to be unfitted for use by the motion of a vessel. The top of this table always rests in a horizontal plane irrespective of the pitch, roll, or motion of the vessel, and is so arranged that the use of the table is not interfered with. The table-top may be extended or folded outward for use for a large number of persons, such changes in size being readily made by lever-connecting means.

LINOTYPE-GALLEY.—F. E. MILHOLLAND, Brooklyn, N. Y. In carrying out this invention the object is to construct a linotype-galley so that it may be locked up—that is to say, so that the type may be locked firmly in the galley. The inventor accomplishes this by a movable barrier arranged in the galley and having a certain novel form of locking lever and spring.

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The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $5. Munn & Co., publishers, 361 Broadway, N. Y.

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Contract manufacturers of hardware specialties, machinery stampings, dies, tools, etc. Excellent marketing connections. Edmonds-Metzel Mfg. Co., 778-784 W. Lake Street, Chicago.

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WANTED.—Catalogues and price lists of all kinds of commodities, novelties, household articles, etc., suitable for marketing through agents or mail order trade. Eagle Commercial Co., Box 932, Philadelphia, Pa.

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(9018) M. E. B. asks: I understand that the difference between the static and other electric currents is its high voltage and extreme low amperage. Now, what is average voltage and amperage of an electric static current from a common static machine of 16 plates running at moderate speed? A. The voltage of the discharge of a static machine depends upon the distance between the discharging rods. A spark of one inch in air under ordinary conditions requires perhaps 28,000 volts. The matter is treated in Thompson's "Elementary Lessons," quite fully. 2. Could a current similar to the static in voltage and amperage be procured from batteries (or lighting street current) and coils? A. Any induction coil gives the same kind of secondary discharge as a static machine. 3. If cells to be used, how many would you need, say of the Laclede national No. 7 to generate such a current? A. A coil giving a one-inch spark should be run with two or three cells of battery; one giving an eight-inch spark with six to eight cells of potassium bicarbonate battery. 4. Describe making the coil or series of coils to produce the static current effect, procured from batteries, and from city lighting current of about 110 voltage. A. A coil giving a six-inch spark is described in SUPPLEMENT No. 1124, price ten cents. 5. Is there such a machine made (in the market) to give static current effect from batteries or city current? A. Induction coils are for sale by all dealers in electric apparatus. 6. Give name of book, brief and comprehensive, for making coils in general for medical batteries, etc. A. Norrie's "Induction Coils" is a good and recent book on coil making.

(9019) C. M. asks: What is the best way, for practical use, to cut down a current of 220 volts to the strength of a Mesco dry battery? A. The Mesco dry cell has a voltage of about 1.5. The current depends upon the resistance of the external circuit, but on short circuit would scarcely exceed 1.5 to 3 amperes. To cut the current of a 220-volt circuit down to 1.5 amperes will require about 150 ohms. No. 24 iron wire is large enough for this, and you will need about 1,000 feet. 2. Does it matter what the amperage is? A. We have shown you above that the amperes must be taken into account in your calculations just as much as the volts. 3. What would be the cost of material? A. We are not able to tell you the cost of such an arrangement. That varies much in different localities. 4. If a 16 c. p. light costs $1 per 100 hours, what would this current cost per 100 hours? A. A 16 c. p. light on 220 volts consumes about ¼ ampere. If this costs $1 for 100 hours, 1.5 amperes will cost $6 for the same time. 5. What would two 110-volt lamps connected in series cost at rate mentioned above? A. If the two 110-volt lamps are 16 c. p., they take ½ ampere, and the two in series will cost twice as much as one 16 candle lamp on 220 volts. You will also have twice as much light.

(9020) P. T. P. writes: I have one of your SUPPLEMENTS giving directions for the making of an induction coil for sparking purposes. I have as a condenser about 30 square feet of tinfoil, alternated with sheets of paraffin paper. I use one sheet of paraffin between the tinfoil. The paper is some I made myself; paper about like what I am writing upon, soaked in paraffin. There is a great noise like sparking or buzzing in the condenser when in operation. Does this indicate that the condenser leaks? That the insulating sheets are not what they ought to be? Your SUPPLEMENT directed paper coated with shellac varnish to be used, but I substituted paraffin. Does the difficulty lie here? Would the placing of two sheets overcome the difficulty? A. Paraffin is a suitable material for coating the sheets of paper for a condenser of an induction coil. The paper must be without pores or visible holes. Before coating each sheet must be examined by holding between the eye and a strong light to detect these holes. One sheet of good firm paper is enough to use between two sheets of tinfoil. As we do not know what coil you have built, nor how you built it, we are not able to say what your difficulty may be. Norrie's "Induction Coils," price $1, gives careful instructions for making a coil and the proper size of condenser for each length of spark. One of the most frequent causes of failure in coil making is in getting the condenser too large or too small for the coil. It should be very carefully adjusted to the current to be used. It is possible that the margin of the paper beyond the foil is too small, around which a discharge may take place.

(9021) H. R. asks: 1. What is the "elastic limit," or limit of elasticity, of a body? A. The elastic limit of a body is the amount of deformation which a body will endure and still return to its size and shape when the deforming force is removed. When a permanent change of shape is produced by force, the limit of elasticity is exceeded and the body is weakened. The factor of the elasticity of a body is called its modulus of elasticity. 2. Is it not a fact that a cannon-ball will sink to the bottom of the deepest ocean? A. A cannon ball will sink to the bottom of the deepest ocean. 3. Will a non-magnetic body have any effect on the action of a magnet? A non-magnetic body has no effect whatever upon the action of a magnet.

(9022) T. A. K. asks how to anneal selenium so as to make it sensitive to light. Also, what form of selenium is best to begin with? I have some selenium in a precipitated or powdered form. Is this the best form to use? I wish to coat a metallic (copper) surface with a thin coat or film of sensitized selenium. Is it better to sensitize it before or after it is applied? What is the best shape to put it in to apply it, and how is the best way to apply it? Can it be dissolved and applied while in solution and then made sensitive to light afterward? If so, what is the best chemical to dissolve it in? As stated above, the whole idea is to coat a copper or nickel surface with a very thin coat of sensitive selenium, and what I want is the best way of doing it. If the powdered or precipitated kind is not the best, where can I find the proper kind? A. The face of the plate is thinly covered with the selenium, which must then be melted on and allowed to cool slowly, so as to assume the crystalline form. In the "selenium cell" the coating of selenium is applied to a strip of mica or other substance of high insulating power. Selenium will dissolve in selenium chloride, and will separate from this solution in the metallic form. However, the selenium cell is always made by melting in the selenium, and we can find no accounts as to whether a coating obtained by using a solution in selenium chloride will be sufficiently adherent or sufficiently sensitive. Your powdered selenium, if pure, should be all right.

(9023) A. C. asks: 1. What are the causes of color blindness? Can it be cured? If so, how? If not, why? A. Color blindness is the inability to see a difference between colors which to the normal eye appear quite distinct. It is a defect in the eye, born with it, and usually incurable. True color blindness is not removable by education. The same mistakes in matching colors are repeated constantly by a person after they have been pointed out to him. The only remedy for his mistakes is to avoid all occupations having to do with colors. 2. What is a good way to learn colors? A. One ignorant of the names of colors should learn them by having them pointed out to him. This has nothing to do with color blindness. The test for color blindness is simply in selecting tints which look alike. No names are used.

(9024) B. P. L. S. asks: 1. Is the secondary coil of an induction coil wound in an opposite direction to the primary coil? A. It makes no difference which way the two coils are wound in reference to each other. All large coils are furnished with a reversing switch in the primary circuit, and if the poles are not as desired, the switch is thrown and the current in the primary is reversed. 2. Could a brass tube be used to cover the core of an induction coil to regulate the amount of current? If not, what kind of metal or substance can be used? A. A brass tube cannot be used as a regulator for a coil. It cannot cut off magnetism. An iron tube might be used to screen the primary from the secondary.

(9025) D. G. E. asks: 1. How much and what size wire would it require for a 20-ohm telegraph instrument? A. Almost any size wire from 24 to 30 can be employed for a 20-ohm sounder. It is a matter of convenience simply. 2. How many square feet in a pound of tinfoil? A. The number of square feet in a pound of tinfoil varies with the thickness of the tinfoil. 3. What book is there giving size, resistance, and weight of copper wire? A. A copper wire table will be found in Swoope's "Lessons in Practical Electricity." 4. What is the name of a maker of C. P. battery zinc? A. There is no book on zinc casting. Chemically pure zinc is not used for batteries. Its price is prohibitory. Zinc amalgamated with mercury is just as good. 5. How may a 2-inch hole be made in the center of a glass plate? A. To make a hole through a glass plate, break the tip from a three-cornered or round file. Dissolve some camphor in turpentine. Dip the end of the file in the liquid, and by a twisting motion grind a hole into the glass plate, which must rest upon a level surface. Care should be exercised when the hole is about to break through the glass. After an opening is made through the glass, the hole is worked to its proper size by a round or half-round file. Always keep the file wet with the fluid. Experience is better than any amount of written instruction on this subject. 6. What is the exact diameter of a single cotton-insulated No. 36 copper wire, or how many wires to the inch? A. No. 36 wire is five thousandths of an inch in diameter. This does not include the insulation. This may be thicker or thinner, according to circumstances. 7. If a good ground is made in the return circuit of a telegraph line, is the resistance of the earth greater or less than a No. 12 iron wire? A. The resistance of the earth in the return circuit is taken to be zero. 8. Have you a book on making batteries for amateurs? A. Bottone's "Galvanic Batteries" is the most recent work on this subject.

(9026) J. S. asks: If a bullet were shot from a .30 or .40 army rifle straight up in the air, when it dropped to the earth would it have the same force it had when it left the gun barrel, and would it penetrate the same amount of pine as it would if it were shot direct at it? A. A projectile shot vertically up into the air from any kind of gun does not have the same velocity when in its fall it strikes the ground as when it left the muzzle of the gun on its ascent. The resistance of the air retards it on its upward flight, and hence it does not attain the full height due to its initial velocity. On its fall the retardation of the air prevents it from attaining the full velocity of fall from the point where it ceased to rise. It therefore does not rise to its full distance, nor in falling from its lower position does it attain its full velocity due to that altitude. Both causes act to produce a less velocity when it reaches the earth.

(9027) A. S. asks: 1. Has the so-called double strength sal-ammoniac battery that has a carbon cylinder filled with granulated carbon and a zinc cylinder around that, charged with 8 ounces sal-ammoniac to the cell, any advantage over the ordinary pencil zinc batteries for a telephone? A. The ordinary Le Clanché cell with a pencil zinc answers perfectly for a telephone, and there seems to be no need to use any stronger one. 2. I want to put a magnet on my telephone line similar to the relay on the telegraph lines. Could it be wound with No. 20 wire? A. You can put an electro-magnet on a telephone line, and it can be wound with No. 20 wire. 3. Would it interfere with the talking qualities of the line? A. It would lengthen the line by so much and would make it so much more difficult to transmit through the line. 4. How many cells of the above-mentioned double-strength sal-ammoniac batteries would it take to work said magnets, if I had say twenty on a line forty miles long? A. Probably twenty cells would prove strong enough to work through twenty magnets. If they were not, more could be added. No one can tell how many will be needed, since that depends on the magnets, the connections, and the leakage, due to moisture and other causes on the line. 5. Could I use a telephone over the same line, say with only two cells in each 'phone? Would there be any more resistance in those magnets wound with No. 20 wire than there is resistance on the line wire? A. You can telephone through the magnets if you use power enough. You will find that out by trying. 6. What size wire is the ordinary telephone extension bell magnets wound with? A. We have not at hand the size of the wire in the extension bell. There is no reason why it should not be about the same as in the polarized calling bell attached to the magneto, since it is rung by the magneto. 7. Which requires the greatest current to work it—a horseshoe magnet, with its two poles working together, or the ordinary extension bell magnets, the wire being the same size? A. The extension bell with polarized magnet is more sensitive than the ordinary bell with electro-magnets simply. 8. How many turns of say No. 20 wire should I put on each end of the horseshoe magnet to make it lift a lever weighing say one drachm, when the current is passing, and let it fall as soon as the current stops? A. We should suppose that you could use ordinary relays of low resistance for your magnets far more cheaply than to make the magnets by hand. These will lift a drachm with a small current, and would be exactly alike, if ordered to be made alike.

(9028) J. F. P. asks: Can you tell me anything that will prevent the formation of chrome alum crystals in a battery using a bichromate of potash solution? A. There are three ways of avoiding the troublesome crystals in a bichromate battery. One is to use chromic acid in the cell. The second is to use a saturated solution of bichromate of sodium in place of the bichromate of potash. No crystals form. The third is to make the solution after the formula which follows: Take 1 part of potassium bichromate, 2½ parts of water, and 3½ parts of sulphuric acid, all by weight. Dissolve the bichromate in the water by boiling, and allow the solution to cool. Then pour the sulphuric acid into the solution slowly and with constant stirring. The mixture becomes very hot, and at a certain point changes its color in a marked manner. This is the moment when decomposition takes place and chromic acid is formed. When all the acid is stirred in, let the solution stand over night. A large crop of crystals will form. These are the alum crystals, and as they are of no use in the liquid, they may be separated by decanting the liquid or by filtering through asbestos. If these crystals are fully gotten rid of, no others will form as the battery is used. This method is due, we understand, to the veteran Prof. A. K. Eaton.

(9029) H. S. asks: 1. How much weight will a cubic foot of gas sustain in mid-air? A. A cubic foot of air at 30 inches of the barometer, and the freezing temperature, weighs 1.29 ounce. A cubic foot of coal gas varies in weight from 0.56 ounce to 0.73 ounce. The sustaining power is the difference of the weights of air and gas. This gives from 0.73 ounce to 0.87 ounce. The lifting power is slightly less than these numbers. 2. What will be the entire weight of the lightest 6 horse power force that can be had, suitable for an airship? A. The lightest 6 horse power motor will weigh about 250 pounds. 3. In ascending, will the attraction of gravity be greater than close to the earth? A. The attraction of gravity *decreases* as you rise above the earth. This decrease in the force of gravity is so small that it would not be noticeable for any distances to which a balloon ascends. For five miles it amounts to nearly a quarter of a pound in a hundred pounds. As scales for weights as large as 100 pounds rarely mark less than quarter pounds, it is evident that so small a change is not practically of any moment. The change in weight is calculated in the following manner: The mean diameter of the earth is 7,918 miles. The distance from the center to the surface is 3,959 miles. Five miles above the surface is 3,964 miles from the center. According to Newton's Law of Gravitation, the weight of a body five miles above the surface of the earth is to its weight at the surface of the earth as the squares of these distances taken inversely; that is, $\left(\frac{3959}{3964}\right)$ × its surface weight. This somewhat large fraction reduced to a decimal gives 0.9975 nearly. Hence 100 pounds at the surface of the earth will weigh 99.75 pounds if carried to a height of five miles above the surface of the earth.

(9030) J. W. O. says: 1. A weekly paper tells about a new and wonderful explosive compound called thermite—a mixture of aluminium filings and oxide of chromium, which when touched off with a match, using flash-light powder for a primer, a heat of over 5,000 deg. is instantly produced, melting great bodies of iron or steel instantly. The paper says it is in use in Germany for welding steel rails, etc. Can you tell anything about it, and give the details? A. Thermite, properly speaking, is a mixture of aluminium powder and iron oxide. Barium peroxide is the primer most used. The heat generated is very intense; the aluminium is burned to the oxide at the expense of the oxygen combined with the iron, and the iron is reduced to the metal and melted. It is being largely used in Germany for the purpose mentioned, and thousands of miles of rails are said to have been welded together by this process. It offers also an effective means of repairing shafts, gearing, broken lugs, etc., being thus a very great saving, as it obviates the necessity of completely replacing the broken part. Its manufacture is patented, and is in the hands of a very strong company. The inventor of the process is Hans Goldschmidt. There are a whole class of mixtures made of aluminium powder with different metallic oxides; all these are also called thermite compounds, but the specific name of "thermite" is applied to the one above described. The other mixtures are useful for the preparation of metals and alloys that are otherwise difficult to prepare; such as metallic chromium, molybdenum, tungsten, titanium, manganese, etc. By mixing the oxides, alloys can be directly produced. The commercial possibilities of these are very great. 2. I read in a book called "The Wonders of the World" that one ounce of the fulminate of gold was enough to totally destroy the city of New York. Has this statement any truth for its basis? What are the facts in the case?

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What is its explosive force compared with rifle powder or nitro-glycerine, and why is it not used for explosive purposes? A. The claim that one ounce of gold fulminate could destroy New York City is absurd. The fulminates are all explosive; only one has any commercial use, and that is the mercury fulminate. It is used as detonator only. The fulminates are all far too expensive, and are also too unstable for any use as explosives. Mercury fulminate can be used for rifles, but it is never done, for reasons specified.

(9031) A. M. Works asks: What should be the diameter and width of an undershot waterwheel to develop about two horse power when fixed in a current of six miles an hour. A. The area of each bucket should be 4 feet; the most suitable shape may be 4 feet wide, 1 foot deep, and have an immersion of 1¾ feet above the periphery. The wheel should be 8 feet in diameter, have 12 buckets, and should run at from 9 to 12 revolutions per minute acording to its work.

(9032) J. A. S. writes: Please inform me in regard to the elevation of the Mississippi River; as to whether it is higher at its mouth than at its source, and please state how much, if possible. A. The Mississippi River, on the gravity plane, is about 426 feet higher at St. Louis than at its mouth in the Gulf of Mexico. All levels on the globe are referred to the gravity plane, which is about 13¼ miles nearer the earth's center at the poles than at the equator. This plane is the true basis upon which all level data are made. Uphill and downhill always refer to the gravity plane. Its relation to a perfect sphere is the cause of much misunderstanding and discussion among people, either from the desire for a catch argument or from want of truthful knowledge of the facts. Water never runs uphill, although St. Louis is nearer the earth's center than the mouth of the Mississippi River.

(9033) W. F. H. asks: 1. In a permanent steel ring [O] magnet are there any poles? If so, what determines their location? A. In a magnetized steel ring the poles may be placed at any points desired by making those points the places from which the magnets leave the ring when the ring is magnetized. That is, pull the ring from the magnets, or the magnets from the ring, at the points where you desire poles to be located. Of course it is easier to place the poles at diametrically opposite points of the ring. 2. Are the magnetic lines of force the same in a permanent steel magnet as in an electro-magnet? If so, why could not the permanent magnetic field be made to revolve an armature as well as an electro-magnet field? A. Permanent magnets were first used for the fields of dynamos and motors. They are not now used because they cannot be made as strong as electro-magnets, and they are liable to lose their magnetism by jars, etc. 3. Why is there a *neutral* point midway between the poles of a magnet? A. The neutral point of a magnet is the point or line on which there is just as much positive as negative force, and not the point or line of no force. Break a magnet on the neutral line and two poles are found on the ends of the two pieces. They were there before the bar was broken. The pole at the end of a magnet is due to the fact that there is no magnetism of the opposite sort to render it inactive. Put the opposite poles of two magnets together, either bar or horse shoe, and the poles at the point of contact disappear, not because they are destroyed, but because their mutual attraction prevents any of the lines of force escaping into the air at that place. If all lines of force can find their way around the magnetic circuit without emerging into the air they are not discoverable from the outside and the circuit is not discoverable from the outside. The metal acts as if it were not magnetized. Only the lines which leak out of the metal are to be detected by any of our methods. 4. Will you please inform me how the noise and vibration of a heavy printing press, on the second floor of a business block, can be prevented or measurably deadened, to prevent the annoyance it causes to tenants on the first floor? A. It is a difficult matter to so deaden a floor that the noise from a heavy printing press will not be heard in the room below. A layer of deadening material could be put over the floor and a second floor laid on that with some advantage. A deadening layer of mortar or other material can be put into the space between the floor and ceiling below. A second ceiling can be put into the room below, enclosing an air space and reducing the height of the lower room by six to ten inches. These various expedients have all been employed and all together will reduce the annoyance as much as it can be reduced.

(9034) E. G. asks: Will you inform me how to prepare silk for making a small balloon to hold gas for about two or three weeks? Could I use paper instead of silk? The balloon must be about 3 feet long, 2 feet wide, and lift about 3 ounces. It is to be used indoors. Can I use anything besides above-mentioned materials? A. Silk is prepared for use in a balloon by varnishing it. It should be stretched tight, and the varnish applied in the usual way. When dry it can be used. Good boiled linseed oil forms an excellent coating for balloons. An India rubber coating may be used. It is prepared as follows: India rubber, 1 pound, cut small; oil of turpentine, 6 pounds; boiled linseed oil, 1 gallon. Digest the India rubber in the turpentine in a warm place for a week, frequently shaking the vessel; then place it in a water bath, and heat slowly till the solution is complete. Next add the oil, previously warmed, simmer gently for five minutes, stirring all the while, after which closely cover it over, and when cold strain through flannel. You could probably make a balloon of such small size and for indoor use of tissue paper.

NEW BOOKS, ETC.

THE WOMAN WHO TOILS. Being the Experience of Two Ladies as Factory Girls. By Mrs. John Van Vorst and Marie Van Vorst. New York: Doubleday, Page & Co. 1903. Pp. ix, 303.

This book may well be considered as a detailed study of one phase of the life which "the other half" lives, as Jacob Riis has told us. That the woman who toils is exposed to even greater temptations and to greater misery than the man who toils, many of us have perhaps suspected. Just what this woman must endure has been set forth by the two authors of this book in a way that is anything but cheerful. The picture is true; and because it is true it is gloomy. Here and there it is brightened a bit, particularly when the conditions that prevail in some of the better factories are described. On the whole, the conditions of the working girl as they are set forth in this book are decidedly deplorable, to say the least.

RACQUETS, TENNIS, AND SQUASH. By Eustace Miles, M.A. Illustrated with 54 photographs and 16 diagrams. D. Appleton & Co. 1903.

This work at once demands recognition as an authority upon the games mentioned above, owing to the fact that the author is a past-master in the art, and has made a deeper study of the theory of "games of the court" than any other living player. The work is divided into several parts; the first part being "Hints on Training," in which the author describes preparatory exercises, the proper methods of breathing, massage, work, rest, etc., preliminary to putting one's self in fit condition for the strenuous side of these sports. The chapter on food and diet will probably be viewed somewhat askance by the ordinary Anglo-Saxon, as the regime suggested by the author is somewhat too rigorous and crude for most people engaged in active forms of exercise. The author describes and illustrates a number of methods of developing the stroke at home, both for Tennis and Racquet, in which the ball is suspended by means of tackling in such a manner that the various strokes may be practised in leisure moments when the much-sought-after court cannot be obtained. Plans of both tennis and squash courts are shown, which will be of service to those who propose to lay out private grounds. Anyone who wishes to perfect himself in the game should certainly have this book before him, as it will soon be considered a standard authority. Lists of the winners of the championships in both America and England are published in the book. It will be noted that Mr. Miles has won the amateur tennis championship in England in 1899, 1901, and 1902, and also the American amateur tennis championship in 1900.

INORGANIC CHEMISTRY. With the Elements of Physical and Theoretical Chemistry. By J. I. D. Hinds, Ph.D. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. 1902. 8vo. Pp. viii, 566. Price, $3.

This volume is intended to supply a rather complete text-book on inorganic chemistry and a handy reference-book for all students and teachers of chemistry. The author has endeavored to present an orderly and systematic treatment of the subject without reference to any teaching method, so that the teacher may go from chapter to chapter as his own method requires. Part I. contains a good general introduction to chemistry and a logical division of the subject into its principal branches. Part II. gives such an outline of physical chemistry as is necessary to the full understanding and appreciation of the descriptive portion of the work. Part III. discusses theoretical chemistry with more than usual thoroughness. It is the purpose of Part IV. to treat, with the fullness which it deserves, every known chemical element, and the compounds which are of commercial and theoretical interest. In classification and treatment the periodic system has been closely followed. We are pleased to note that the author has adopted the modern spelling of chemical terms, recommended by the Chemical Section of the American Association for the Advancement of Science.

THE DESIGN OF SIMPLE ROOF-TRUSSES IN WOOD AND STEEL. With an Introduction to the Elements of Graphic Statics. By Malverd A. Howe, C.E. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. 1902. Pp. 129. Price $2.

In his preface Prof. Howe modestly asserts that very little, if anything, new will be found in the pages of his book. Nevertheless, the book finds its justification in the fact that it has brought together in small compass all the essentials required in the proper designing of roof-trusses. Although the timber roof-truss is considered by many engineers somewhat antiquated, Prof. Howe has deemed it worthy of discussion, and not without reason, we think. His treatment of the steel truss is contained in the sixth chapter of the book, in which he says what he has to say in a terse, technical way. The method of discussion which Prof. Howe has adopted is both graphical and mathematical.

ANIMALS BEFORE MAN IN NORTH AMERICA. Their Lives and Times. By Frederic A. Lucas. New York: D. Appleton & Co. 1902. 12mo. Pp. vii, 291. Price, $1.20.

This book pictures the early life of our continent, tells something of the fishes that once swam about its shores, of the reptiles that splashed through the swamps, and of the great mammals that once roamed over the western plains. All this Mr. Lucas has told with a certain charm that relieves his work of much of the monotony that would be expected of a subject of so scientific a character. His book may be said to occupy a position midway between the technical manual and the popular description of historical animals.

THE THERMODYNAMICS OF HEAT-ENGINES. By Sidney A. Reeve. New York: The Macmillan Company. London: Macmillan & Co., Ltd. 1903. 12mo. Pp. xi, 316. Price $2.60.

The author his divided his book into two parts. The first is devoted to theory, and the second to the application of theory to practice. In the first part he discusses the general principles of energetics, the cycle, the thermal properties of matter, the steam engine cycle, and the laws of permanent gases, gas engine cycles, hot air engines, heat engine possibilities, and refrigerating machines. In the second part he discusses the simple steam engine, the compound steam engine, and the Otto gas engine. The appendix is comprised of tables.

HARDENING, TEMPERING, ANNEALING AND FORGING OF STEEL. By Joseph V. Woodworth. New York: Munn & Co. 1903. 8vo. Pp. 288, 200 illustrations. Price $2.50.

A new work from cover to cover, treating in a clear, concise manner all modern processes for the heating, annealing, forging, welding, hardening and tempering of steel, making it a book of great practical value to metal-working mechanics in general, with special directions for the successful hardening and tempering of all steel tools used in the arts, including milling cutters, taps, thread dies, reamers, both solid and shell, hollow mills, punches and dies, and all kinds of sheet metal working tools, shear blades, saws, fine cutlery, and metal cutting tools of all description, as well as for all implements of steel both large and small. In this work the simplest and most satisfactory hardening and tempering processes are given. The uses to which the leading brands of steel may be adapted are concisely presented, and their treatment for working under different conditions explained, also the special methods for the hardening and tempering of special brands. In connection with the above numbers of "kinks," "ways" and "practical points" are embodied, making the volume a text book on the treatment of steel as modern demands necessitate.

A chapter devoted to the different processes for case-hardening is also included, and special reference made to the adoption of machinery steel for tools of various kinds. The illustrations show the mechanic the most up-to-date devices, machines and furnaces which contribute to the attainment of satisfactory results in this highly important branch of modern tool-making.

DIES; THEIR CONSTRUCTION AND USE FOR MODERN WORKING OF SHEET METALS. By Joseph V. Woodworth. New York: Munn & Co. 1903. 8vo. Pp. 384, 505 engravings. Price $3.

A treatise upon the designing, constructing and use of tools, fixtures and devices, together with the manner in which they should be used in the power press, for the cheap and rapid production of sheet-metal parts and articles. Comprising fundamental designs and practical points by which sheet metal parts may be produced at the minimum of cost to the maximum of output, together with special reference to the hardening and tempering of press tools, and to the classes of work which may be produced to the best advantage by the use of dies in the power press. A complete treatise on the subject and the most comprehensive and exhaustive one in existence. A book written by a practical man for practical men, and one that diemakers, machinists, toolmakers or metal-working mechanics cannot afford to be without.

This work shows engravings of dies, press fixtures and sheet-metal-working devices, from the simplest to the most intricate in modern use, and the author has described their construction and use in a clear, practical manner, so that all grades of metal-working mechanics will be able to understand thoroughly how to design, construct and use them, for the production of the marvelous variety of sheet-metal articles and parts which are now in general use. Many of the dies and press fixtures shown and described herein were constructed by the author, others under his supervision; while others were constructed by some of our most skillful mechanics and used in some of the largest sheet-metal goods establishments and machine shops in the United States. A very much needed book and an important addition to the literature of mechanics.

THE JOURNEY'S END. A Romance of To-day. By Justus Miles Forman. Illustrated by Karl J. Anderson. New York: Doubleday, Page & Co. 1903. 12mo. Pp. 240. Price $1.50.

KALENDER FÜR ELEKTROCHEMIKER SOWIE TECHNISCHE CHEMIKER UND PHYSIKER FÜR DAS JAHR 1903. VII. Jahrgang. Herausgegeben von Dr. A. Neuberger. Mit einer Beilage. Berlin: Verlag von M. Krayn. Pp. xxx, 600.

REPORT OF THE MINISTER OF AGRICULTURE FOR THE DOMINION OF CANADA FOR THE YEAR ENDED OCTOBER 31, 1902. Printed by Order of Parliament. Ottawa. 1903. Pp. lxiii, 284.

SMITHSONIAN INSTITUTION. Bureau of American Ethnology. J. W. Powell Director. Bulletin 27. Tsimshian Texts. By Franz Boas. Washington: Government Printing Office. 1902. Pp. 244.

SPECIFICATIONS FOR LANCASHIRE BOILER AND BOILER SEATING. By Inspector M.I.M.E. Manchester: Technical Publishing Company, Ltd. 1903. 8vo. Pp. 23.

THE MENTAL STATUS OF CZOLGOSZ, THE ASSASSIN OF PRESIDENT MCKINLEY. By Walter Channing, M. D. Brookline, Mass. From the American Journal of Insanity. Pp. 46.

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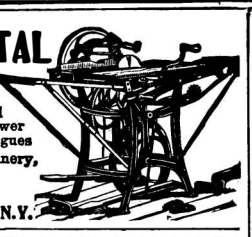

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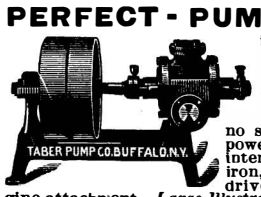

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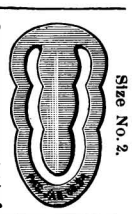

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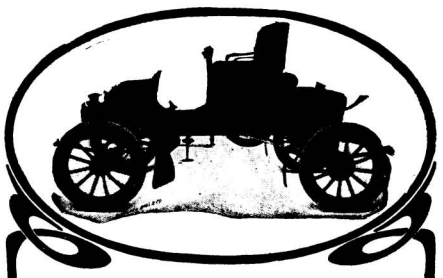

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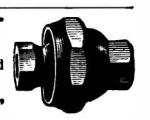

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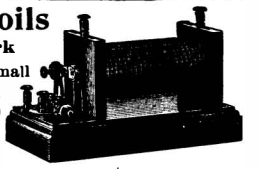

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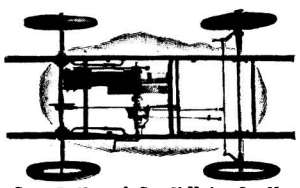

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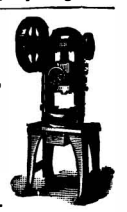

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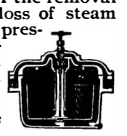

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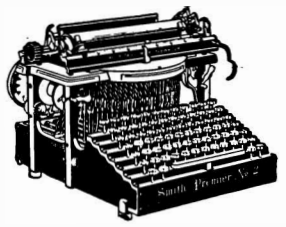

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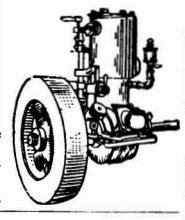

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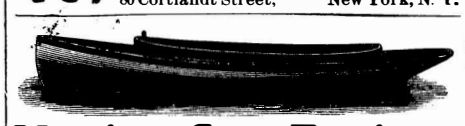

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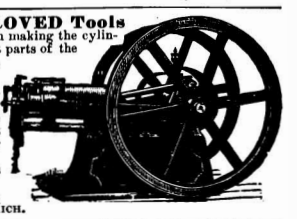

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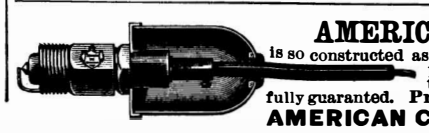

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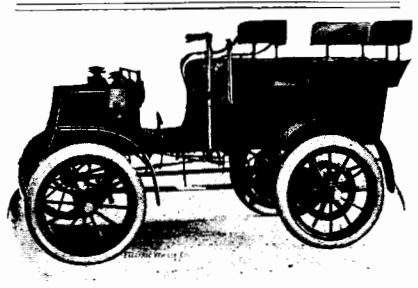

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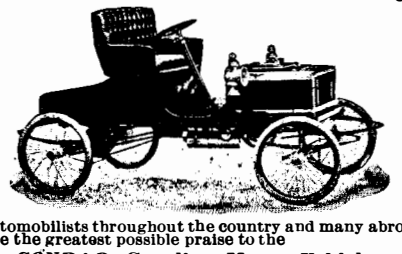

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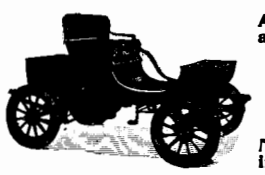

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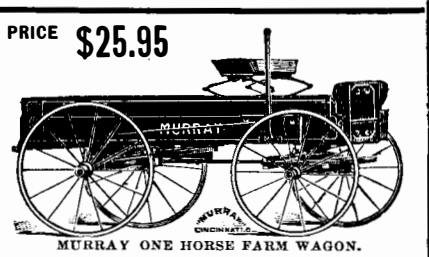

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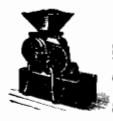

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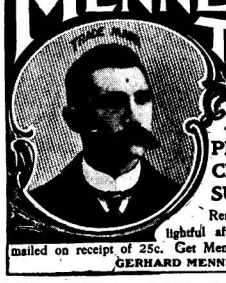

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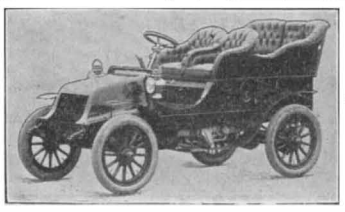

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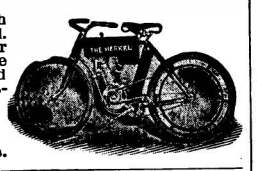

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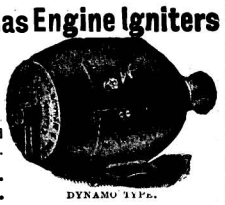

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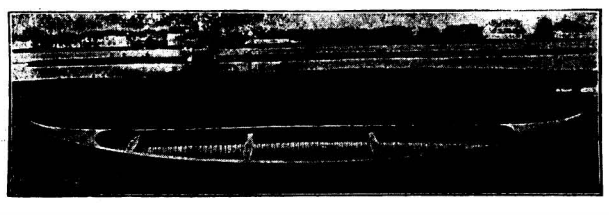

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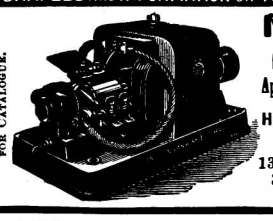

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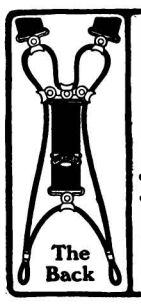

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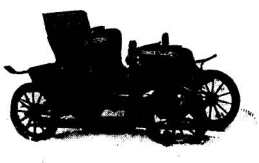

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